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BIOPHYSICAL AND SIGNIFICANT ECOLOGICAL FEATURES OF THE KOOTENAY PLAINS ECOLOGICAL RESERVE

GEOWEST
Environmental Consultants Ltd.

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BIOPHYSICAL AND SIGNIFICANT ECOLOGICAL FEATURES OF THE KOOTENAY PLAINS ECOLOGICAL RESERVE

Prepared for:

Resource Data Division
Alberta Environmental Protection
Edmonton, Alberta

Prepared by:

D.R. Bruhjell, P.M. Sherrington, J.A. Bentz and A. Saxena

GEOWEST Environmental Consultants Ltd.

Suite 203, 4209 - 99 Street
Edmonton, Alberta T6E 5V7

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EXECUTIVE SUMMARY

The Kootenay Plains Ecological Reserve is situated within the Montane Subregion of the Rocky Mountain Natural Region, some 50 km southwest of Nordegg, Alberta (Alberta Environmental Protection 1994a). The study area encompasses approximately 34 km^2 and parallels, but does not include the North Saskatchewan River and Abraham Lake. It is bisected by both the North Saskatchewan and Siffleur rivers.

Increased activity (petroleum exploration, forestry, ranching, recreation etc.) in the Rocky Mountains and the resulting surface disturbances have put pressure on sensitive areas within the region. *GEOWEST* Environmental Consultants Ltd. was contracted to undertake a study, commissioned by Alberta Environmental Protection, Edmonton, to conduct a biophysical land classification inventory and identify and map significant features and sensitive features in support of resource management initiatives within the Kootenay Plains Ecological Reserve.

Specific objectives of the project were:

- To conduct a biophysical inventory at the ecosite hierarchical level within the Kootenay Plains Ecological Reserve study area at a scale of 1:20 000.
- To conduct a significant ecological features and sensitive features inventory within the study area.
- To provide digitized ARC/INFO format biophysical maps and legends for the study area at a scale of 1:20 000.
- To provide digitized ARC/INFO format thematic maps of significant ecological features and sensitive features at a scale of 1:20 000.
- To provide a summary report according to specifications outlined in the Terms of Reference.

Fifteen different vegetation community types were identified, with classification based on vegetative composition and landscape attributes that influence vegetation community development. The forested regions of the study area are dominated by the Lodgepole pine/Canada buffaloberry/hairy wild rye and the White spruce/Canada buffaloberry/feathermoss community types while the grasslands are dominated by the Northern wheat grass-June grass/pasture sagewort and Limber pine/bearberry/June grass community types.

Inter-mountain grassland vegetation combined with forested environments provide habitat for a variety of wildlife species within the Kootenay Plains Ecological Reserve. As many as 76 species of birds and 49 species of mammals may use habitats in the Reserve. Included among the wildlife assemblage of the Kootenay Plains area are numerous species which have been identified as requiring special management attention. For example, the Committee on the Status of Endangered Wildlife in Canada has designated grizzly bear, wolverine, and great gray owl as vulnerable species. Additional species have been designated by the provincial government as being either sensitive or at risk. In the Kootenay Plains area, these species include mammals such as Columbian ground squirrel, timber wolf, cougar, lynx, long-tailed weasel, fisher, elk and bighorn sheep as well as birds such as osprey, bald eagle, three-toed woodpecker, pileated woodpecker, mountain chickadee, winter wren, varied thrush, and a few waterfowl species.

The Kootenay Plains study area possesses some unique physical and topographic features, including a wide valley dominated by a complex system of glaciofluvial terraces, alluvial fans and active floodplains. Many surfaces of the valley floor and adjacent lower slopes have also been covered by a veneer of calcareous loess derived mostly from the floodplain.

The scenic beauty, abundant natural resources and ease of access have subjected the Kootenay Plains study area to increased recreational and other land use pressures. It is hoped that this document, in

combination with others, can be used as an initial source of information by both industry and government agencies to "flag" potential areas of concern. Detailed field study may often be necessary to confirm site-specific occurrences of significant flora and fauna within the study area.

ACKNOWLEDGEMENTS

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Particular thanks are due to Ms. Marilyn Rayner and Mr. Keith Ainsley, Resource Data Division, Alberta Environmental Protection for guidance throughout the project and provision of base map materials, as well as fieldwork assistance by Mr. Ainsley. In addition, we would like to thank John Sisson for preparation of final maps and figures, and Terry Lang for word processing.

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1.0 INTRODUCTION

1.1 Project Objectives

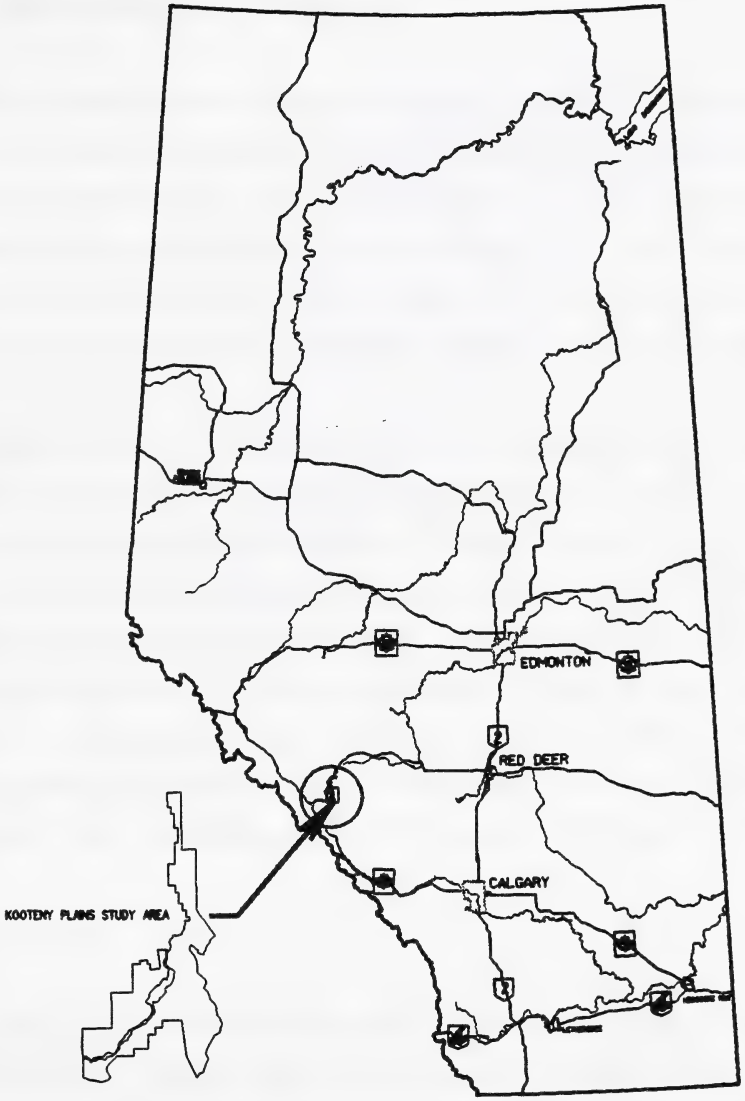
The purpose of this study, as commissioned by Alberta Environmental Protection, Edmonton, was to use existing and new information to conduct a biophysical inventory and identify significant and sensitive features present in the Kootenay Plains Ecological Reserve. The specific objectives of this project were:

- To conduct a biophysical inventory at the ecosite hierarchical level within the Kootenay Plains Ecological Reserve study area at a scale of 1:20 000.
- To conduct a significant ecological features and sensitive features inventory within the study area.
- To provide digitized ARC/INFO format biophysical maps and legends for the study area at a scale of 1:20 000.
- To provide digitized ARC/INFO format thematic maps of significant ecological features and sensitive features at a scale of 1:20 000.
- To provide a summary report according to specifications outlined in the Terms of Reference.

1.2 Study Area Desciption

The Kootenay Plains Ecological Reserve is situated within the Montane Subregion of the Rocky Mountain Natural Region, some 50 km southwest of Nordegg, Alberta (Alberta Environmental Protection 1994a) (Figure 1). The ecological reserve is 32 km^2 in size and is bisected by both the North Saskatchewan and Siffleur rivers. It is found in portions of Townships 36 and 37 and Ranges

FIGURE 1: LOCATION OF THE KOOTENY PLAINS STUDY AREA



17 and 18 W5M. Access to the area is via Highway No. 11.

1.2.1 Legal Designation and Management

Ecological Reserves are areas selected as representative or special natural landscapes which are protected as examples of functioning ecosystems, as gene pools for research, and for education and heritage appreciation purposes. The Kootenay Plains Ecological Reserve was established in 1987 pursuant to the province's *Wilderness Areas, Ecological Reserves and Natural Areas Act* (1980). Kootenay Plains Ecological Reserve is important as the only protected area representative of the Montane Sub-Region of the Rocky Mountain Natural Region in central Alberta.

The original Reserve covered an area of 3,204 ha but public concerns expressed during the management planning process spurred a boundary expansion to 3,439 ha in 1995. The boundary change was implemented in order to resolve several land-use conflicts (e.g., overlap with TransAlta's Water Development Lease) and to include various special features, such as Siffleur Falls. The 1995 boundary extension follows the Siffleur River drainage upstream to the edge of the Siffleur Wilderness Area. The study area under consideration throughout this report corresponds to the new boundary of the Kootenay Plains Ecological Reserve. For a detailed history of Reserve designation in the Kootenay Plains area, readers are referred to the Kootenay Plains Ecological Reserve Management Plan, currently being finalized by the Alberta Department of Environmental Protection.

1.2.2 Climate

The Kootenay Plains Ecological Reserve is found within the Montane Subregion of the Rocky Mountain Natural Region (Alberta Environmental Protection 1994a). This subregion is characterized by chinooks and is intermittently snow-free in the winter. Since specific

meteorological data for the Kootenay Plains is scarce, this report will focus on the general climate of the Montane Subregion, presented in Table 1. Comparisons are made with similar data collected for the nearby Subalpine, Alpine and Boreal Uplands.

The montane climate is generally dry and windy. This is enhanced by a ingress of warm Pacific air via the North Saskatchewan River valley corridor. The resulting climate is one that experiences moderate winter temperatures and increased winter precipitation (Wells and Downing 1994).

Annual precipitation of the Montane Subregion is between 250 to 440 mm. Based on data presented by Pettapiece (1971), this figure can be narrowed down to an average of 280 mm for the Kootenay Plains. By contrast, the Subalpine and Boreal Uplands have between 500 to 750 mm and 350 to 650 mm of annual precipitation, respectively. High average windspeeds and the "rain-shadow" effect result in high evapotranspiration rates for the area. Prevailing winds are from the west to northwest.

Average mean summer temperatures (May to Sept.) are between 10 to 11°C. The Subalpine and Boreal Uplands, by contrast, have average annual temperatures of between 6 to 10°C and 9 to 11.5°C, respectively. Average mean winter temperature (Dec. to Feb.), as shown in Table 1, of the Montane subregion is also generally higher than the other ecoregions. Total frost-free days for this subregion range from 50 to 90 days. The Kootenay Plains Ecological Reserve has a fairly uniform regional climate. Considerable variation however, can occur in yearly rainfall patterns. Dry springs are common, sometimes causing drought-like conditions, especially on southern aspects. In 1966-67, Pettapiece (1971) reported only 140 mm of annual precipitation. Local topography can also modify the local climate because of variations in elevation, slope and aspect.

Table 1. Summary of climate data for the Kootenay Plains Ecological Reserve (after Wells and Downing 1984).

Ecoregion	Anuual Precip. (mm)	Precip. May-Sept. (mm)	Precip. Oct.-April. (mm)	Frost-Free Days	Mean Temp. May-Sept. (°C)	Mean Temp. Dec.-Feb. (°C)
Montane[1]	250-440	150-200	100-220	50-90	10-11	-6.5-(-)9.5
Boreal Uplands[2]	350-650	190-400	150-250	20-100	9-11.5	-9-(-)12
Subalpine[2]	500-750	250-400	250-350	50-70	6-10	-7.5-(-)12
Alpine[2]	500-900	250-500	250-400	0-40	-7	-14

[1] Represents a generalized Montane climate, figures given in text override table.
[2] Included for comparison purposes

1.2.3 Physiography and Bedrock Geology

The study area is located in the Front Ranges of the Rocky Mountains occurring along both sides of the North Saskatchewan River valley and continuing adjacent to the southern portion of Abraham Lake. Topographic conditions can be described as gently to moderately inclined lower valley slopes gradually transforming into a relatively level to gently sloping floodplain. Elevations vary from a topographic high of approximately 1730 masl (meters above sea level) to a topographic low of 1340 masl, although most of the study area lies between 1350 and 1430 masl (Wallis and Wershler 1981).

The North Saskatchewan River flows across a region underlain by a complex series of folded and thrust-faulted strata. McPherson (1970) described the bedrock as being predominantly sedimentary and metamorphic. Igneous rocks however, were found to be rare, occurring only as minor local

intrusions. Wells and Downing (1994) described the mountain peaks of this region as being composed mostly of limestone, dolomite and calcareous shales and the North Saskatchewan River valley as being underlain by less resistant sandstones and shales.

1.2.4 Surficial Geology

During the Tertiary period, the valley system of the study area was initially cut by stream action (McPherson 1970). This was followed by at least two major glacial advances in the upper portion of the North Saskatchewan valley. McPherson (1970) proposed that the last glacial advance (the main advance) took place during the late Wisconsin time of the Pleistocene. The age of the first advance however, was more difficult to predict. Subsequent to the melting, a depth of at least 107 meters of sands and gravels were laid down in the valley bottom. Uniformity of these sediments suggest that they were deposited over a long ice-free period. The second ice advance is responsible for the landforms presently found in the study area. This advance reworked the deposits laid down by the first glaciation forming distinct landforms like the drumlins and fluted ground moraine found between Thompson Creek (west of the study area) and the mouth of the Siffleur River.

Since the study area is comprised priimarily of the lower elevations of the North Saskatchewan River valley, morainal deposits were not commonly mapped. The morainal materials found, primarily occurred on the upper slopes and consisted of unstratified sand, silt and clay.

The dominant surficial deposit found within the Kootenay Plains Ecological Reserve is of glaciofluvial origin. The structure of these materials can be attributed to the slow meltdown of the glaciers that last occupied this valley. These glaciers did not retreat continuously; it was more of a "falling apart." This process resulted in areas remaining glaciated and others, ice free. During the "meltdown" period, huge amounts of glacial meltwater from the former ice took over the leading

role in landscape forming processes. A large amount of gravel and sand (glaciofluvial outwash sediments from the glaciers) was deposited in the foreland of the ice and in channels along the ice sheets. It was a period of alternating erosion and deposition of material - the amount of materials either eroded or deposited was a function of the amount of available water (Aeschlimann and Bruhjell 1995). The terraces that result from these processes are found throughout the study area. These terraces are primarily glaciofluvial and are characteristically very stony, consisting of a mixture of sand, silt and clay. Ground moraine blankets over bedrock forms rolling surfaces in areas that contained persistent ice during the general pro-glacial deposition associated with the "meltdown" phase of deglaciation. This landform type is located above 1475 masl, some 120 m above the North Saskatchewan valley, and includes limited glaciofluvial deposition in minor linear channels.

The valley floor is dominated by a complex system of terraces, alluvial fans and active floodplains. Fluvial erosion and deposition appear to have been the dominant means of recent landform modification. Terraces and floodplains are composed of moderately to well sorted and stratified sands and gravels while alluvial fans contained moderately sorted and stratified sands and gravels.

Colluvial deposits are also present in the study area. These deposits characteristically consist of a mixture of angular rock fragments with some sand, silt and clay. A variety of landforms including poorly developed talus cones consisting of angular fragments, talus aprons and fan-like features were formed by these materials.

Most of the surficial deposits of the Kootenay Plains are covered with a thin silty eolian (loess) veneer up to 30 cm thick, the exceptions being only the steepest or most eroded slopes. The silt and sand characteristic of this veneer is primarily derived from the floodplain and deposited by the strong westerly winds of this area.

Shallow organic deposits can also be found sporadically throughout the study area. The depth of these deposits are generally less than 30 cm. These are present in depressions in ground moraine located in the southern part of the study area.

1.2.5 Soils

Soils belonging to the Brunisolic order dominate the study area. These soils have sufficient development to exclude them from the Regosolic order, but they lack the degree or kind of horizon development specified for soils of other Orders. Brunisols under forest conditions generally have a brownish-colored Bm horizon at least 5 cm thick. Soils from both the Eutric and Orthic Great Groups of the Brunisolic Order were found in the Kootenay Plains Ecological Reserve. This Great Group is separated from the Dystric Great Group based on the pH of the uppermost 25 cm of soil. Dystric Brunisols have a pH less than 5.5 in the uppermost 25 cm while Eutric Brunisols have a pH of 5.5 or greater in the uppermost 25 cm. The occurrence of only Eutric Brunisols reflects the bedrock geology of the region as the pH of the bedrock strongly influences the pH of the surficial materials.

Soils belonging to the Regosolic order are also very common in the study area. These soils were commonly found on the North Saskatchewan River floodplain and on the steeper slopes throughout the region. These soils are "young" and generally lack well-developed profiles. This poor inherent development may be due to many factors including, the youthfulness of the material (i.e., recent alluvium), instability of the material (i.e., colluvium on slopes subject to mass wasting), the nature of the material (i.e., dominated by quartz sand) and climate (i.e., cold, dry environments).

Soils belonging to the Luvisolic order are rare in this area. Luvisols generally have light-colored, eluvial A horizons and illuvial B horizons in which silicate clay has accumulated. A Luvisolic

B horizon must have the specified increase in clay over that in the eluvial horizon, clay skins indicative of translocated clay accounting for 1% or more of the area of a section through the horizon, and be at least 5 cm thick. Only soils from the Gray Luvisol Great Group were found within the study area. These soils usually have well-developed, platy Ae horizons of low chroma, Bt horizons with moderate to strong blocky structures, calcareous C horizons, and a sola of high base saturation. Gray Luvisols typically occur under forest or mixed forest vegetation and in a wide range of climatic areas.

Soils of the Gleysolic order were not commonly sampled in the Kootenay Plains. These soils have features indicative of periodic or prolonged saturation by water and the sites are typified by reducing conditions. Gleysols often occur in shallow depressions and on level lowlands that are saturated with water, generally every spring. They are usually associated with either a high groundwater table at some period of the year or temporary saturation above a relatively impermeable layer. Vegetation often differs from the surrounding soils due to the moisture content and poor internal drainage. Gleysols have either matrix colors of low chroma or distinct to prominent mottles of high chroma in the upper 50 cm. This suggests localized oxidation of ferrous iron and deposition of hydrated ferric oxides. Although these soils were not commonly sampled in the study area, it is probable that they dominate poorly drained sites.

Soils belonging to the Organic order are rare throughout this area. These soils are composed largely of organic materials. They include most of the soils commonly known as peat, muck, or bog soils. Organic soils are generally saturated with water for long periods. They occur mainly in areas that are very poorly drained and are derived from the vegetation that grows in these areas. Organic soils must contain at least 30% organic matter by weight and are classified based on the level of decomposition of this organic material. This material can be either folic, fibric, terric, mesic, or humic. Only soil belonging to the Mesisol Great Group was described in the study area. Mesisols

are composed mainly of partially decomposed organic materials. Stages of decomposition of organic materials are defined in the von Post scale of decomposition classes.

1.2.6 Vegetation

The vegetation of the Kootenay Plains exists due to many environmental variables including physiography, climate, fire and grazing intensities. The climate of the area is strongly influenced by the Rocky Mountains. Chinooks combined with a "rain-shadow" affect, produce high evapotranspiration rates allowing drought tolerant vegetation like grassland communities to prevail. Extensive lodgepole pine (*Pinus contorta*) stands also suggest fire prevalence along the North Saskatchewan River valley. Fire history when combined with the effects of grazing (Wallis and Wershler 1981) produce conditions that tend to favour grassland communities over deciduous tree communities. Wallis and Werschler (1981) determined that feral and domestic horse overgrazing on the east side of the North Saskatchewan river had occurred up to at least 1979. This overgrazing has reduced species diversity and increased mineral soil exposure making dry grasslands even drier. Historical reports taken from Wallis and Wershler (1981) however, record large concentrations of elk (*Cervus elaphus*) and bison (*Bison bison*) in the river valley. Thus, it appears that this ecosystem has historically been subject to periodic occurrences of fire and overgrazing. Present field data also suggests heavy ungulate use, both past and present, in this valley. Continual patterns of overgrazing could explain the absence of foothills rough fescue (*Festuca campestris*), a common montane species.

The vegetation of the Kootenay Plains has previously been identified as a significant biological resource with disjunct montane woodland and grassland plant communities (Wallis and Werschler 1981). The Montane subregion is characterized by warmer and drier conditions than the surrounding Subalpine and Alpine subregions, somewhat cooler and moister conditions than the lower elevation

grasslands to the east, and frequent chinook conditions in winter. Vegetation characteristically consists of a mosaic of forests and grasslands. Upland sites are dominated by lodgepole pine forests while white spruce (*Picea glauca*) forests generally occur on fluvial terraces and along watercourses. Aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*) stands are generally restricted to fluvial fans and terraces. Although Douglas Fir (*Pseudotsuga menziesii*) widely occurs in the Montane subregion (Strong 1992), and is documented as occurring within the study area, (Alberta Environmental Protection 1995), its presence was not supported by this study.

Most exposed rock outcrops and many well to rapidly drained slopes are dominated by limber pine (*Pinus flexilis*) and shrub communities. Other well drained sites including southern aspects, floodplains, terraces and fans are dominated by grassland communities. Northern wheatgrass (*Agropyron dasystachyum*), June grass (*Koeleria macrantha*) and various forbs typically form large components of these communities. Nonnative plant invasion in the ecological reserve in minimal. Significant populations are restricted to areas that are continually disturbed, primarily trails, roadsides, and braided river flats.

The actual community and species representation at any given site will be influenced by numerous factors, including disturbance regimes, regional climate, aspect, slope steepness, moisture and nutrient regimes and grazing intensities.

Detailed discussion of the vegetation of the study area is presented in Sections 3.2 and 4.4.

1.2.7 Wildlife

Of the complex web of factors which influence wildlife species distribution and abundance in a given region, habitat, or vegetation, communities are the most critical. Since vegetation cover is

actually an expression of a variety of biophysical conditions such as soil, aspect, and relief, it generally offers a current prediction of habitat suitability for most wildlife species. The Kootenay Plains Ecological Reserve is located in montane and sub-alpine environments characterized by a complex system of terraces, alluvial fans and active floodplains. As a result, vegetation cover ranges from lodgepole pine (*Pinus contorta*) of varying density over much of the area while extensive forests of limber pine (*Pinus flexilis*) occur on bedrock exposures and black spruce (*Picea mariana*) are prevalent in low, wet areas along the river. Deciduous and mixedwood forests and riparian shrublands are also found at lower elevation valleys within the study area.

Apart from the forested communities, open grassland found on the alluvial fans are also considered critical wildlife habitats. Climatically-determined grassland is the potential natural vegetation on 33 million km^2, or 25 percent of the earth's land surface (Lauenroth 1979). They occur in areas having a period of the year when soil water availability falls below the requirements for forests, yet they receive sufficient precipitation to sustain grasses (*Graminae*) as the dominant form of vegetation. Most of these such areas occur either between deserts and forests or in the rain shadow of major mountain ranges. The grasslands of the Kootenay Plains Ecological Reserve are an example of the latter, located within the Front Range of the Rocky Mountains.

The Kootenay Plains area has previously been identified as a significant biological (and geological) resource with distinct montane woodland and grassland communities (Wallis and Wershler 1981, Kondla 1979). Detailed descriptions of these vegetation communities can be found in Wallis and Wershler (1981) and in Section 3.2 of this report.

Inter-mountain grassland vegetation combined with forested environments provide habitat for a variety of wildlife species. Wallis and Wershler (1981), identified 65 species of birds, 14 mammals and 2 amphibians that have been recorded in the Kootenay Plains area. However, more recent

investigations into geographical ranges of mammals (Smith 1993) and birds (Semenchuk 1992) in Alberta indicate that these numbers may actually be as high as 76 species of birds and 49 species of mammals. Included among the wildlife assemblage of the Kootenay Plains area are numerous species which have been identified as requiring special management attention. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has designated grizzly bear (*Ursus arctos*), wolverine (*Gulo gulo*), and great gray owl (*Strix nebulus*) as vulnerable species (COSEWIC 1995). Additional species have been designated by the provincial government as being either sensitive or at risk. In the Kootenay Plains area, these species include mammals such as Columbian ground squirrel (*Spermophillus columbianus*), long-tailed vole (*Microtus longicaudus*), timber wolf (*Canis lupus*), cougar (*Felis concolor*), lynx (*Lynx canadensis*), long-tailed weasel (*Mustela frenata*), fisher (*Martes americana*), elk (*Cervus elaphus*) and bighorn sheep (*Ovis canadensis*) as well as birds such as osprey (*Pandion heliaetus*), bald eagle (*Haliaeetus lencocephalus*), three-toed woodpecker (*Picoides tridactylus*), pileated woodpecker (*Dryocopus pileatus*), mountain chickadee (*Parus gambeli*), winter wren (*Troglodytes troglodytes*), varied thrush (*Ixoreus naevius*), and a few waterfowl species (*Anas* spp. and *Aythya* spp.).

The use of appropriate habitats in the Kootenay Plains Ecological Reserve by these species varies. Some are resident breeders in the study area while others make only facultative use of some habitats. Nonetheless, diverse vegetation communities in the Kootenay Plains area provide habitat for forest-interior obligates, early seral and edge-associated species, and aquatic and riparian species. Waterfowl habitat throughout the southern half of the study area is generally of poor quality as adverse terrain limits the development or permanence of wetlands.

The lower reaches of the Siffleur River, and other large permanent streams such as Loudon, Wilson and Whiterabbit Creeks, which join The North Saskatchewan River, are populated by 13 fish species, including 6 salmonids, 3 catostomids, 2 cyprinids, 1 coregonid, and 1 cottid. However, Tebby

(1974a) described The North Saskatchewan River basin as the most naturally depauperate of Alberta's major watersheds, as several of the large tributaries and many of the smaller ones have no native fish. Bull trout (*Salvelinus confluentus*) have been identified by Berry (1994) as the only native trout to occur in all major East Slopes drainages and the only stream-dwelling trout native to the North Saskatchewan River. Distribution of this species in Alberta correlates closely with high elevation headwaters, rendering habitats within the Kootenay Plains study area extremely critical.

2.0 METHODS

2.1 Field Survey

Field sampling was conducted from August 1 to August 5, 1995 and July 8 to July 12, 1996 according to methods outlined in the Ecological Land Survey Site Description Manual (Alberta Environmental Protection 1994b). Initially, potential field sample sites were selected by using aerial photographs. Site locations were chosen to document the range of environmental conditions throughout the area. At each site, information was collected on soils, parent materials, vegetation composition and site characteristics, using standard field plot forms. Wildlife observations were also recorded. In total, 62 detailed plots were established in the Kootenay Plains Ecological Reserve including 23 detailed plots sampled in 1996 in the area added to the ecological reserve. The portions of the ecological reserve removed in the course of boundary changes accounted for 11 of the 50 detailed plots sampled in 1995. Plant taxonomy follows Moss (1983) with common names conforming to the Alberta Vegetation Species List (Alberta Forestry, Lands and Wildlife 1992). Photographs were also taken at most sites to illustrate physiographic and physiognomic characteristics.

2.2 Ecological Land Classification Methods

Ecological Land Classification (ELC) is a hierarchical landscape mapping system in which the land surface is subdivided and classified into areas of similar environments. The map units are characterized by recurring patterns of surficial materials, landform, soil and vegetation.

The primary method used to derive ecological units is aerial photo interpretation. The land surface is delineated according to factors such as slope, landform, drainage, parent materials and vegetation.

After background data compilation and the initial interpretation, field checks are carried out to verify descriptions of the map units and to compile more detailed site, soil and vegetation information.

To classify and map ELC units, the landscape is generally divided into a four-tiered hierarchical system based on dominant landscape characteristics - Ecoregion, Ecodistrict, Ecosection and Ecosite. The basic unit used for mapping in this study was the Ecosite level at a mapping scale of 1:20,000. Final cartography was also completed at a scale of 1:20,000. The higher levels of classification were considered in the initial interpretation but omitted from the final mapping.

Each ecosite unit was given a descriptive map unit symbol. For example, for the ecosite symbol GF1, GF describes the primary landform, in this case glaciofluvial, while the following numeric character, 1, describes a subdivision based on soil, vegetation or physiographic features.

2.3 Identification of Significant Features

The identification of significant features, particularly of rare flora and fauna, relied heavily on review of existing information as time constraints precluded the undertaking of intensive surveys required to identify populations in the field. Extrapolation was often required of data from studies in adjacent areas to the study area. Detailed field study will be required in many cases to confirm the occurrence of significant flora and fauna specifically within the study area. The significance of sites within the Kootenay Plains Ecological Reserve was based on a consideration of 14 criteria, including:

- areas which perform a vital environmental, ecological or hydrological function such as aquifer recharge
- areas that contain rare or unique geological or physiographic features

- areas that contain significant, rare or endangered plant or animal species
- areas which are unique habitats with limited representation in the region or are small remnants of once larger habitats which have virtually disappeared
- areas that contain an unusual diversity of plant and/or animal communities due to a variety of geomorphological features and microclimatic effects
- areas that contain large and relatively undisturbed habitats and provide sheltered habitat or species which are intolerant of human disturbance
- areas which provide an important linking function and permit the movement of wildlife over considerable distances, including migration corridors and migratory stopover points
- areas that contain plants, animals or landforms which are unusual or are of local, regional, provincial, national or international significance
- areas which are excellent representatives of one or more ecosystems, habitats or landscapes
- areas with intrinsic appeal due to widespread community interest or the presence of highly valued features or wildlife species valued for hunting
- areas with lengthy histories of scientific research
- areas containing specific old-growth values or older forest stands
- areas which perform a vital function for wildlife in the area
- areas with cultural, historical or archaeological significance.

The significance of each site was categorized according to Eagles (1984) as follows:

International - features which are unique in the world

National - features which are limited in distribution at a national level or which are the best or only representatives in Canada

Provincial - features which are of limited distribution or are the best examples of a feature in the province

Regional - features which are of limited distribution or are the best examples of a feature in the region

Local - features which are of limited distribution or are the best examples of a feature in the study area.

2.4 Identification of Sensitive Features

Soils, landscape and vegetation information collected during the course of detailed and reconnaissance surveys were used to assist in subsequent mapping of sensitive features. Parameters considered included soil type and texture, slope, topography, parent material and vegetation composition, among others.

2.5 Polygon Database Preparation

A digital database was prepared which incorporated the key characteristics of each map polygon. The database was formatted in dBASE IV and was structured in such a way as to be easily incorporated with spatial data files for future GIS analysis and presentation if required.

As specified in the study Terms of Reference, the following fields were incorporated in the database.

Dominant landscape parameters:

- polygon number
- ecosite
- parent material

- surficial expression
- proportion of polygon
- soil classification to subgroup level
- slope class
- drainage class
- surface soil texture
- subsurface soil texture
- vegetation community type(s)
- Soil permeability class
- depth to bedrock (cm)
- depth to impermeable layer (cm)
- depth to water table (cm)
- surface rockiness class
- surface stoniness class
- shrink-swell potential class
- potential frost action class
- flood hazard class

Subdominant landscape parameters:

- parent material
- surface expression
- proportion of polygon
- soil classification to subgroup level
- slope class
- drainage class
- surface soil texture
- subsurface soil texture
- vegetation community type(s)

Database codes follow the Canadian System of Soil Classification (Canada Soil Survey Committee 1987) for the following parameters:

- parent material
- surface expression
- slope classes
- soil drainage classes

- soil subgroup classification
- soil texture

Potential frost action classes, surface rockiness classes and surface stoniness classes are defined in Appendices 1, 2 and 3 respectively.

Vegetation type numerical codes are defined as follows:

Code	Vegetation Type
1	White spruce/Canada buffaloberry/feathermoss
2	White spruce/common bearberry/northern wheatgrass
3	White spruce/water birch/common bearberry/simple bog sedge
4	Lodgepole pine-white spruce/Canada buffaloberry-common bearberry
5	Lodgepole pine/Canada buffaloberry/hairy wild rye
6	Balsam poplar-white spruce/silverberry
7	Aspen/Canada buffaloberry/hairy wild rye
8	Lodgepole pine-limber pine/common bearberry/northern wheatgrass
9	Limber pine/common bearberry/June grass
10	Creeping juniper/northern wheatgrass-purple reed grass
11	Northern wheatgrass-June grass/pasture sagewort
12	June grass-awnless brome/pasture sagewort
13	Bog birch/sedge/sphagnum
14	Willow/Canada buffaloberry/hairy wild rye
15	Aspen/willow/needle and thread grass

Three thematic maps at 1:20 000 have been produced to accompany this report. These maps include:

- Ecological Land Classification
- Significant Features
- Sensitive Features

3.0 RESULTS

3.1 Ecological Land Classification Mapping

Map units (ecosites) are described in the legend accompanying the Ecological Land Classification map. Biophysical features included in the legend are as follows: vegetation types; landform and surficial materials; soil classification; slope steepness (%); soil drainage; surface soil texture; subsurface soil texture; soil permeability; depth (cm) to bedrock, other impermeable layers or water table; surface rockiness class and surface stoniness class.

Ecosites are arranged alphabetically in the legend according to the surficial material code which forms the first part of the map symbol. The following is a key to the surficial materials and bedrock present in the Kootenay Plains Ecological Reserve:

C	Colluvial
CR	Colluvial and Rock complex
EGF	Eolian and Glaciofluvial complex
F	Fluvial
FR	Fluvial and Rock complex
GF	Glaciofluvial
GFO	Glaciofluvial and Organic complex
M	Moraine
MGF	Moraine and Glaciofluvial complex
MR	Moraine and Rock complex
O	Organics
R	Rock

3.2 Description of Vegetation Community Types

In addition to the influence of regional precipitation and temperature regimes, vegetation community development is influenced by microsite variability in terms of aspect, slope steepness, moisture and nutrient regimes and disturbance factors such as fire, flooding and grazing.

Each community type was identified and delineated based on aerial photo interpretation and field data collection. In total, 15 community types were identified within the study area. They are outlined as follows:

1. White spruce/Canada buffaloberry/feathermoss
2. White spruce/common bearberry/northern wheatgrass
3. White spruce/water birch/common bearberry/simple bog sedge
4. Lodgepole pine-white spruce/Canada buffaloberry-common bearberry
5. Lodgepole pine/Canada buffaloberry/hairy wild rye
6. Balsam poplar-white spruce/silverberry
7. Aspen/Canada buffaloberry/hairy wild rye
8. Lodgepole pine-limber pine/common bearberry/northern wheatgrass
9. Limber pine/common bearberry/June grass
10. Creeping juniper/northern wheatgrass-purple reed grass
11. Northern wheat grass-June grass/pasture sagewort
12. June grass-awnless brome/pasture sagewort
13. Bog birch/sedge/sphagnum
14. Willow/Canada buffaloberry/hairy wild rye
15. Aspen/willow/needle and thread grass

It is expected that each community type will have a relatively wide variation in species composition and abundance from site to site. A description of each type is presented below.

(1) White spruce/Canada buffaloberry/feathermoss:

This climatic climax to mature edaphic climax community type is characteristic of well to imperfectly drained, inclined midslope and valley floor positions. It is similiar to the Canada buffaloberry/hairy wild rye/lodgepole pine vegetation community described for the Montane Ecoregion in Archibold et al 1996, except for the dominance of white spruce (*Picea glauca*). Parent materials vary from medium to coarse textured glaciofluvial and fluvial materials to medium textured, very stony colluvial deposits. Most of these surficial deposits also possess an eolian veneer. Soils of this association are predominately Orthic Eutric Brunisols, Orthic Regosols and Orthic Humic Regosols, with Gleyed Cumulic Regosols on sites with high water tables. Lightly to moderately stocked mature white spruce (*Picea glauca*) dominate the upper canopy of this community. Lesser amounts of lodgepole pine (*Pinus contorta*) and aspen (*Populus tremuloides*) also occur. Regeneration of the above species and balsam poplar (*Populus balsamifera*) occur in varying proportions depending on site characteristics.

The shrub layer is dominated by Canada buffaloberry (*Shepherdia canadensis*). Other species including creeping juniper (*Juniperis horizontalis*) and common bearberry (*Arctostaphylos uva-ursi*) also occur frequently in the low shrub layer. Although this association has the most diverse herb layer seen in the study area, it is usually poorly developed with cover values seldom exceeding 20 percent. Showy aster (*Aster conspicuus*) is the only forb species that consistently occurs with high cover. Other common forbs include early yellow locoweed (*Oxytropis sericea*) and twinflower (*Linnaea borealis*). The graminoid layer is highly variable, with hairy wild rye (*Elymus innovatus*) being the only species typically occurring with greater than ten percent cover. Moss and lichen

commonly dominate the forest floor with cover values ranging between nine and 80 percent.

Common species include stair-step moss (*Hylocomium splendens*), Schreber's moss (*Pleurozium schreberi*), reindeer lichen (*Cladina mitis*) and ground lichen (*Peltigera aphthosa*).

Canada buffaloberry and hairy wild rye generally dominate all forested stands within the study area. This dominance can be attributed to the warm winds and coarse textured deposits that frequently occur throughout this region. These characteristics result in lower available moisture thus promoting the growth of these two species.

(2) White spruce/common bearberry/northern wheatgrass:

The successional status of this community type is young to mature edaphic climax. It is generally found on moderately to coarse textured fluvial materials along the North Saskatchewan River valley. This vegetation community is not described in Archibald et al 1996. Well-drained Orthic Eutric Brunisols dominate these positions. The canopy of this community is dominated by lightly stocked white spruce (*Picea glauca*). No other tree species were identified within the reference sites. Signs throughout the stand suggest that these sites are being periodically disturbed either by flooding or anthropogenic activities. These disturbances combined with the climate of the region result in a poorly developed canopy.

The poorly developed canopy of this association allows for moderate shrub growth. Although this layer shows low diversity, cover is typically greater than 33 percent. Dominant species include common bearberry (*Arctostaphylos uva-ursi*) and creeping juniper (*Juniperis horizontalis*). Canada buffalobery (*Shepherdia canadensis*) was also a common resident of these sites. This community type differs from the White spruce/Canada buffaloberry/feathermoss association in that it shows less

diversity in the forb and moss layers. Common forbs include mountain goldenrod (*Solidago spathulata*), showy locoweed (*Oxytropis splendens*), early yellow locoweed (*Oxytropis sericea*) and tufted fleabane (*Erigeron caespitosus*). The graminoid layer, consisting of northern wheatgrass (*Agropyron dasystachyum*) and June grass (*Koeleria macrantha*), and the forb layer show the transitional forest-grassland status of this association. The species found in these layers are more typical of a grassland community while the presence of white spruce suggests a forested community. Only Schreber's moss (*Pleurozium schreberi*) was found to exist in the moss and lichen layer.

(3) White spruce/water birch/common bearberry/simple bog sedge:

This young to mature edaphic climax community type characteristic of moderately well to very poorly drained sites is not described in Archibald et al 1996. Vegetation is dependant on either a permanently or periodically high water table. Parent materials are primarily fluvial, and often with eolian veneers. Organic soils, specifically Terric Mesisols also exist under this community type. These soils however have a very limited distribution. Mineral soils are primarily Orthic Humic Regosols, Orthic Gleysols and Orthic Humic Gleysols. The canopy of this association is lightly stocked with white spruce (*Picea glauca*). Cover of this species rarely exceeds 8 percent.

Water birch (*Betula occidentalis*) dominates the tall shrub layer while common bearberry (*Arctostaphylos uva-ursi*) is the dominant low shrub. Water birch cover is greatest on wetter sites (20 percent) and decreases dramatically as drainage improves (only 2 percent cover in moderately well drained sites). Some of the most interesting forb species found in the Kootenay Plains occur in this community. Orchids such as northern green orchid (*Habenaria hyperborea*), northern lady's-slipper (*Cypripedium passerinum*) and round-leaved orchid (*Orchis rotundifolia*) frequently inhabit these stands. Other common species include harebell (*Campanula rotundifolia*), white camas (*Zigadenus elegans*), sweet-flowered androsace (*Androsace chamaejasme*), and sticky asphodel

(*Tofieldia glutinosa*). The graminoid layer of this community is diverse and well developed with cover values ranging from 24 to 46 percent. Common species include simple bog sedge (*Kobresia simpliciuscula*), wire rush (*Juncus balticus*), low sedge (*Carex stenophylla*), single-spike sedge (*Carex scirpoidea*) and northern wheatgrass (*Agropyron dasystachyum*).

(4) Lodgepole pine-white spruce/Canada buffaloberry-common bearberry:

This overmature seral community type generally develops on moderate to coarse textured eolian veneers over coarse textured glaciofluvial materials and course-textured moraine over bedrock ridges. Surface expression varies from level floodplains and terraces to inclined terrace side slopes. Moderately well to well-drained Orthic Regosols and Orthic Eutric Brunisols dominate the soils of this community. The canopy dominated by lodgepole pine (*Pinus contorta*) and white spruce (*Picea glauca*) with lesser amounts of aspen (*Populus tremuloides*) is moderately dense, except in areas of recent slope failure, such as on steep valley slopes, and on ridges with exceedingly thin moraine veneers over bedrock. Aspen poplar is relatively more common on steep valley slopes in conjunction with the open lodgepole pine canopy, but again infrequent on bedrock ridges with characteristic open lodgepole pine canopies.

The shrub layer is well developed with the most common species being Canada buffaloberry (*Shepherdia canadensis*), common bearberry (*Arctostaphylos uva-ursi*), creeping juniper (*Juniperis horizontalis*) and common juniper (*Juniperis communis*). Understory herbaceous vegetation is also generally diverse although cover is quite variable depending on overstory density. Characteristic forb species include mountain goldenrod (*Solidago spathulata*), cut-leaved anemone (*Anemone multifida*), and tufted fleabane (*Erigeron caespitosus*). Grass cover is variable with northern wheatgrass (*Agropyron dasystachyum*) and hairy wild rye (*Elymus innovatus*) being the most common species. Feathermoss cover is usually quite sparse.

This community type is similiar to the bearberry-lodgepole pine and bearberry-aspen communities described in Archibald et al 1996, although it is not dominated by forb species characteristic of these communities such as alpine hedysarum (*Hedysarum alpinum*).

(5) Lodgepole pine/Canada buffaloberry/hairy wild rye:

This vegetation type dominates the forested regions of the Kootenay Plains Ecological Reserve. It is described as the Canada buffaloberry/hairy wild rye-lodgepole pine community type for the Montane Subregion in Archibald et al. 1996. Of all the 50 sites sampled for this project prior to the adjustment of the ecological boundaries, this community was found 34 percent of the time. This is an overmature to old seral community type characteristic of moderately well to imperfectly drained, level to undulating midslope positions. Morainal, glaciofluvial, eolian and fluvial deposits are all represented in this association. Orthic Eutric Brunisols are the dominant soil type occurring in over one-half of the sites sampled. Other soils include Eluviated Eutric Brunisols, Orthic Regosols and Orthic Gray Luvisols. Lodgepole pine (*Pinus contorta*) dominates the canopy with lesser occurrences of white spruce (*Picea glauca*). Regenerating tree species include white spruce, lodgepole pine and aspen (*Populus tremuloides*).

Canada buffaloberry (*Shepherdia canadensis*) is the most prevalent component of the shrub layer. A significant inclusion of labrador tea (*Ledum groenlandicum*) occurs in moist situations where this association adjoins bogs. Other common shrubs include common juniper (*Juniperis communis*) and creeping juniper (*Juniperis horizontalis*). Low everlasting (*Antennaria aprica*), wild strawberry (*Fragaria virginiana*), showy aster (*Aster conspicuus*), and twinflower (*Linnaea borealis*) are the most common forbs of a relatively diverse forb stratum. Only hairy wild rye (*Elymus innovatus*) occurs with any frequency in the graminoid layer. The moss layer is generally better developed withstair-step moss (*Hylocomium splendens*) and Schreber's moss (*Pleurozium schreberi*) being the

dominant species. Reindeer lichen (*Cladina mitis*) and studded leather lichen (*Peltigera aphthosa*) can occasionally be found in minor amounts.

(6) Balsam poplar-white spruce/silverberry:

This young to mature edaphic community type is found on well drained floodplain and valley bottom terrace locations where surficial materials consist of medium to coarse textured fluvial materials is not described for the Montane Subregion in Archibald et al. 1996. Soils are typically prone to flooding and are generally classified as Orthic Regosols and Orthic Eutric Brunisols. This community can be described as having stunted, poorly developed stands of balsam poplar (*Populus balsamifera*) and white spruce (*Picea glauca*) in the tree stratum. Cover of these two species is extremely variable and site specific.

In the shrub layer, silverberry (*Elaeagnus commutata*) is dominant, with creeping juniper (*Juniperis horizontalis*), willow (*Salix spp.*) and yellow mountain avens (*Dryas drummondii*) as important associates. Early yellow locoweed (*Oxytropis sericea*), showy aster (*Aster conspicuus*) and wild strawberry (*Fragaria virginiana*) are generally present with greater cover than are other forb species. The graminoid layer, dominated by hairy wild rye (*Elymus innovatus*) and northern wheatgrass (*Agropyron dasystachyum*), is variable occupying anywhere from five to 36 percent of the ground surface. Moss and lichen species occur infrequently in this community.

(7) Aspen/Canada buffaloberry/hairy wild rye:

This young to mature edaphic community type is found on well drained, coarse textured soils with high water tables which develop on inclined fluvial materials along streams and colluvial materials. It has been classified in Archibald et al. 1996 as the Canada buffaloberry/hairy wild rye-aspen

community type. Soils are generally Orthic or Cumulic Regosols. The tree layer is dominated by aspen (*Populus tremuloides*), often less than ten meters in height.

The shrub layer in this community is generally well developed averaging 70 percent cover. Canada buffaloberry (*Shepherdia canadensis*) is the most dominant species, while other common shrubs include prickly rose (*Rosa acicularis*), creeping juniper (*Juniperis horizontalis*) and common juniper (*Juniperis communis*). The forb layer of this community type tends not to be as diverse or as well developed with showy aster (*Aster conspicuus*), common red paintbrush (*Castilleja miniata*) and ascending purple milk vetch (*Astragalus striatus*), and wild strawberry (*Fragaria virginiana*) being the most common species. Hairy wild rye (*Elymus innovatus*) dominates the graminoid layer averaging 35 percent cover. Moss and lichen cover is generally low with stair-step moss (*Hylocomium splendens*) and Schreber's moss (*Pleurozium schreberi*) being the dominant species.

(8) Lodgepole pine-limber pine/common bearberry/northern wheatgrass:

This mature edaphic community type, found on rapidly drained, level to inclined medium textured deposits, is not described in Archibald et al. 1996. Sites typically occur on exposed rock outcrops, eroding morainal and colluvial slopes and alluvial fans. Soils are predominately Orthic Eutric Brunisols. The overstorey is generally dominated by variable aged lodgepole pine (*Pinus contorta*), and to a lesser degree limber pine (*Pinus flexis*). Isolated populations of alpine fir (*Abies lasiocarpa*) are also present.

The shrub layer is dominated by common bearberry (*Arctostaphylos uva-ursi*), Canada buffaloberry (*Shepherdia canadensis*) and creeping juniper (*Juniperis horizontalis*). Additional shrub cover is provided by prickly rose (*Rosa acicularis*), common juniper (*Juniperis communis*) and shrubby cinquefoil (*Potentilla fruticosa*). The herb layer is generally poorly developed with low species

diversity. Common species include pasture sagewort (*Artemisia frigida*), tufted fleabane (*Erigeron caespitosus*), golden aster (*Heterotheca villosa*) and wild vetch (*Vicia americana*). Grasses include northern wheatgrass (*Agropyron dasystachyum*), hairy wild rye (*Elymus innovatus*) and Rocky Mountain fescue (*Festuca saximontana*).

(9) Limber pine/common bearberry/June grass:

This is a mature climatic climax community type found on rapidly drained, lower slope, medium to coarse textured glaciofluvial materials with discontinuous eolian veneers. Soils are primarily Orthic Eutric Brunisols and Orthic Regosols. Lightly stocked limber pine (*Pinus flexilis*) form the canopy of this community.

Common bearberry (*Arctostaphylos uva-ursi*) dominates a moderately well developed shrub layer. Other common shrubs include creeping juniper (*Juniperis horizontalis*) and shrubby cinquefoil (*Potentilla fruticosa*). The forb layer is generally poorly developed with cover rarely exceeding 24 percent. Common forbs include bastard toadflax (*Comandra umbellata*), pasture sagewort (*Artemisia fruticosa*), tufted fleabane (*Erigeron caespitosus*) and prairie groundsel (*Senecio canus*). June grass (*Koeleria macrantha*) is the dominant grass with northern wheatgrass (*Agropyron dasystachyum*) and western wheatgrass (*Agropyron smithii*) also making up large components of the graminoid layer. In general, this community type occurs in extremely dry areas. This characteristic results in poorly developed forb and graminoid layers. When combined, the cover of these layers rarely exceed 50 percent. Bare soil and *Cladina spp.* typically form the remainder of the ground surface.

This community type can be separated from the limber pine/juniper-douglas fir community type described in Archibald et al. 1996 by the presence of June grass and absence of rough fescue

(*Festuca scabrella*) and Douglas fir (*Pseudotsuga menziesii*).

A 1000 year-old limber pine within the study area has been nominated as "a tree of renown" due to its extreme ecological and historical value.

(10) Creeping juniper/northern wheatgrass-purple reed grass:

This mature edaphic community type occurs sporadically on lower slopes, valley floors and ridges throughout the study area. It is generally restricted to alluvial fans and glaciofluvial terraces with thin eolian veneers and bedrock ridges with colluvial veneers. Rapidly drained Cumulic and Orthic Regosols are the dominant soils. The tree layer of this community type is poorly developed, rarely exceeding five percent and typically being less than one percent cover. Lodgepole pine (*Pinus contorta*) was the only tree species identified in these stands. This community occurs in direct association with the Northern wheatgrass-June grass/pasture sagewort community type (mentioned below). It differs by having a greater occurrence of depressional areas dominated by creeping juniper (*Juniperis horizontalis*) with common bearberry (*Arctostaphylos uva-ursi*) dominating the shrub layer of the drier sites. Drought tolerant forbs, such as, low everlasting (*Antennaria aprica*) and pasture sagewort (*Artemisia frigida*) dominate the forb layer. Compared to the shrub and forb layers, the graminoid layer is well developed, typically exceeding 80 percent cover. This characteristic can be attributed to the variable moisture regimes existing in these areas. Northern wheatgrass (*Agropyron dasystachyum*) is generally restricted to drier areas while purple reed grass (*Calamagrostis purpuracens*) and hairy wild rye (*Elymus innovatus*) increase cover in depressional areas not dominated by creeping juniper. Other common grasses include June grass (*Koeleria macrantha*), slender wheatgrass (*Agropyron trachycaulum*), narrow wheatgrass (*Calamagrostis stricta*) and early bluegrass (*Poa cusickii*). A hybridized species between northern wheatgrass and hairy wild rye was also identified.

This community type can be separated from the Canada buffaloberry/hairy wild rye-lodgepole pine community type described in Archibald et al. 1996 by the lack of white spruce and dominance of grasses such as northern wheatgrass and purple reed grass.

(11) Northern wheat grass-June grass/pasture sagewort:

This Northern wheatgrass-June grass/pasture sagewort climatic climax community type, the most extensive grassland community type found within the Kootenay Plains Ecological Reserve is not described in Archibald et al. 1996. It is generally restricted to well-drained alluvial fans and glaciofluvial materials. These materials, combined with other soil and climatic characteristics as well as, fire and grazing history restrict the establishment of a tree canopy, allowing a grassland community to persist. However, the encroachment of trees can be noticed in some areas. All of the common tree species found within the Kootenay Plains Ecological Reserve including white spruce (*Picea glauca*), lodgepole pine (*Pinus contorta*), aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*) can be found within the shrub layer of this community type. A few scattered mature white spruce also occur as single trees or in small clumps. Vegetation is graminoid-dominated, and highly variable. The size of the vegetation plots (20 by 20 meters) prevented a more detailed breakdown of species cover such as that presented in Wallis and Wershler (1981). The large plot size was chosen so that an overall assessment of the grassland communities could be provided. Various "subcommunities" dominated by Richardson needle grass (*Stipa richardsonii*), needle-and-thread (*Stipa comata*), mat muhly (*Muhlenbergia richardsonis*), western wheatgrass (*Agropyron smithii*) and slender wheatgrass (*Agropyron trachycaulum*) occur throughout this community, depending on site specific moisture and soil conditions. Northern wheatgrass (*Agropyron dasystachyum*), June grass (*Koeleria macrantha*), purple reed grass (*Calamagrostis purpuracens*) and Rocky Mountain fescue (*Festuca saximontana*) tended to occur throughout all of the identified

Northern wheatgrass-June grass/pasture sagewort communities. The forb stratum is highly variable with cover values ranging from 14 to 69 percent. Likewise with the shrub layer. Half of the sample sites had no shrubs recorded, while shrub coverage within the other sample plots was generally under 25 percent. Common forbs include pasture sagewort (*Artemisia frigida*), dragonwort (*Artemisia dracunculus*) and wild blue flax (*Linum lewisii*) while common shrubs include creeping juniper (*Juniperis horizontalis*), common juniper (*Juniperis communis*) and common bearberry (*Arctostaphylos uva-ursi*).

Both disturbance factors and edaphic soil conditions contribute to the development of this and the other grassland community types. Periodic flooding, burning and grazing combined with rapid runoff and high evapotranspiration rates form conditions favorable for grassland vegetation. If disturbance is removed, aspen and balsam poplar suckers are allowed to encroach, eventually forming a tree canopy. This reduces evapotranspiration rates causing grassland species to be out competed and aspen and balsam poplar to dominate. This process is extremely slow in this area and highly dependant on site-specific conditions. Some areas are just too dry and grazed too heavily for tree species to encroach, while others have a wetter moisture regime allowing this process to occur. If fire is suppressed, these wetter grassland communities can be expected to decrease and deciduous tree communities to increase.

(12) June grass-awnless brome/pasture sagewort:

This mature climatic community type, not described in Archibald et al. 1996, is found on areas that are frequently disturbed either by flooding, recreational activities or grazing. It is commonly associated with active and inactive alluvium, and glaciofluvial materials. Eolian veneers are also common. Soils are predominately well to moderately well drained Orthic Humic Regosols. The canopy of this community is generally poorly developed. Aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*) and white spruce (*Picea glauca*) are primarily restricted to areas not

recently disturbed. This community is typically found in association with other frequently disturbed communities including the Aspen/Canada buffaloberry/hairy wild rye and Balsam poplar-white spruce/silverberry communities.

The shrub layer is very poorly developed with creeping juniper (*Juniperis horizontalis*) being the only common species. The forb and grass layers, however, are very well developed. Common forbs include pasture sagewort (*Artemisia frigida*), dragonwort (*Artemisia dracunculus*), wild blue flax (*Linum lewisii*) and nodding onion (*Allium cernuum*). Similar to the Northern wheatgrass-June grass/pasture sagewort community type, the species composition of the graminoid layer is highly variable. June grass (*Koeleria macrantha*) and awnless brome (*Bromus inermis*) dominate all sites while slender wheatgrass (*Agropyron trachycaulum*) increases in poorly drained areas. High cover values of Hooker's oat grass (*Helitrichon hookeri*) also exist within this community.

13) Bog birch/sedge/sphagnum

This mature edaphic shrubland vegetation community, not described in Archibald et al. 1996, occurs next to water courses, along seepage tracks and/or around water bodies where moisture is abundant. The mineral soil typically has a thin organic veneer generally less than 20 centimeters in thickness. Cover of bog birch (*Betula glandulosa*) and willow (*Salix spp.*) is variable with shrub cover being completely absent in some areas. Forb layer composition and development is highly variable with no dominant species. Sedges (*Carex spp.*) and rushes (*Juncus spp.*) generally dominate a well-developed graminoid layer. A near-continuous layer of sphagnum (*Sphagnum spp.*) dominates the wettest areas within these sites.

14) Willow/Canada buffaloberry/hairy wild rye

This is a young to mature edaphic community type characteristic of imperfectly drained, valley floor

positions not described within the Canada buffaloberry/hairy wild rye-lodgepole pine community type of Archibald et al. 1996. Parent materials are dominated by coarse-textured glaciofluvial and fluvial materials with negligible recent fluvial processes present. Soils of this unit are predominantly Gleyed Eutric Brunisols. This community type occurs in narrow, linear valleys and is dominated by willow (*Salix spp.*), with a significant inclusion of forbs such as twinflower (*Linnaea borealis*) and showy aster (*Aster conspicuus*) and grasses such as hairy wild rye (*Elymus innovatus*). It is typically associated with the lodgepole pine/Canada buffaloberry/hairy wild rye community type, but comprises only a minor component (less than 10 percent).

(15) Aspen/willow/needle and thread grass

This young to mature edaphic shrubland community not described in Archibald et al. 1996, occurs on slightly inclined, periodically active fluvial fans overlying former fluvial channels of The North Saskatchewan River. Parent materials are somewhat complex, due to varying depositional environments, featuring moderately to imperfectly drained fine-textured material forming veneers over small, coarse sand lenses and bands of eolian loess. Dominant soils are Cumulic Regosols and Gleyed Cumulic Regosols.

The slightly inclined fans/abandoned fluvial channels are dominated by vegetation communities with a banded configuration indicative of several successional stages. Aspen and white spruce, which forms the outer band of vegetation, is encroaching on willow/needle-and thread grass and willow/bog birch vegetation. Cover of bog birch (*Betula glandulosa*) and willow (*Salix spp.*) is variable, with shrub cover being sparse in some areas. Forb layer composition and development is variable with no dominant species. Needle and thread grass (*Stipa comata*) and exotic smooth brome (*Bromus inermis*) generally dominate the well-developed herb layer. This association contains several uncommon plant species such one-flowered ironplant (*Happlopappus uniflorus*).

Other minor plant communities and unique species assemblages are found throughout the study area. They are not identified above because of the biophysical survey methodology employed, and the relatively low sampling intensity attained during 1995 field work. A more comprehensive description of these communities and species assemblages can be found in Wallis and Wershler (1981) and in Appendix 4 of this report.

4.0 SIGNIFICANT FEATURES

Environmentally significant features (ESFs) are areas which are deemed to be important to society in terms of ensuring the maintenance of ecological processes or by the provision of useful products. As well, these areas are often sensitive to disturbance (Wallis 1991).

The entire Kootenay Plains Ecological Reserve can be considered significant due to the presence of montane woodland and grassland in a disjunct locality (Sweetgrass Consultants Ltd. 1989). Many rare wetland and calcareous cliff habitats, not represented elsewhere in Alberta, are also present within the reserve. The Kootenay Plains also serve as an important ungulate wintering ground.

Significant features of the Kootenay Plains Ecological Reserve are summarized below. Significant areas or sites or areas deserving special mention are also identified here, with a detailed discussion of each being presented in Section 6.0 and in Map 2.

4.1 Significant Geological/Landform Features

The most significant geological features of the Kootenay Plains are the calcareous cliffs that provide habitat for regionally uncommon plant species such as prairie selaginella (*Selaginella densa*), slender lip fern (*Cheilanthes feei*) and smooth cliff brake (*Pellaea glabella*). Mineral licks are also documented within the study area. Of these, an important mineral lick near Whirlpool Point provides salt for the areas ungulate population.

Whirlpool Point, an isolated bedrock massif in the southern part of the study area is considered a significant feature because it is a unique landform, supports a tree of renown, and provides outstanding wildlife habitat in its immediate environs.

4.2 Significant Hydrological Features

The most prominent hydrological feature of the Kootenay Plains area, but excluded from the Ecological Reserve, is the North Saskatchewan River. This river also supports a diverse fish population and is crucial to the survival of numerous plant and wildlife species. Water courses including the Siffleur River, Whiterabbit Creek, and Loudon Creek also perform important functions, such as, directing waterflow towards the North Saskatchewan River. The spectacular Siffleur Falls are described as "the most noteworthy hydrological feature within the Ecological Reserve" by Alberta Environmental Protection (1995). The Siffleur Canyon contains unique plant and animal habitat, in addition to having fossil exposures around a plunge pool below the falls. Braided streams also contain features such as meander pools and channel edges which provide habitat for significant plant communities and habitats (Alberta Environmental Protection 1995). Braided streams have regionally significant plant species such as youngia (*Crespis elegans*).

Isolated ponds, wetlands and springs can be found throughout the study area. These features provide habitat for plant and wildlife species uncommon in this area. Two ponds west of the Siffleur River attract a few species of waterfowl and shore birds as well as amphibians and aquatic insects, while a particularly significant wetland is found along Highway No. 11, north of Whirlpool Point. This wetland is the only waterfowl habitat within the area that is used to any extent. Alkaline ponds existing within old meander scars, as identified by Kondla (1974) and Wallis and Wershler (1981), provide localized habitat for plant species such as short-awned sedge (*Carex microglochin*), sea milkwort (*Glaux maritima*), alpine bearberry (*Arctostaphylos rubra*) and northern lady's-slipper (*Cypripedium passerinum*). Calcareous fens and springs occurring adjacent to the North Saskatchewan River also provide habitat for regionally uncommon plant species such as water birch (*Betula occidentalis*) and simple bog sedge (*Kobresia simpliciuscula*) in addition to providing habitat for shorebirds, amphibians, and aquatic insects. Emergent zones and channel edges in general are recognized as being significant for their plant communities and value as wildlife habitat.

4.3 Significant Archaeological Features

The Kootenay Plains Ecological Reserve Management Plan (Environmental Protection 1995) has identified at least twenty-three prehistoric sites known to exist within the Kootenay Plains Ecological Reserve. This estimate, however, was based on the expanded boundaries of the reserve which occurred in 1995. Since these sites are extremely sensitive, it was requested by Environmental Protection to purposely exclude them from the Significant Areas map found in this report. Archaeological studies within the Reserve have been sporadic and project specific. The only extensive survey was conducted prior to the construction of the Big Horn Dam in 1972. Another study conducted in 1987 focused on the potential of selected landforms to have ancient sites greater than 8000 years of age. This study showed that the existing inventory represented only a percentage of the number believed to exist within the Reserve.

Historically, the North Saskatchewan River was used as an important trade and travel corridor linking the Alberta Plains to the interior of British Columbia. Transitory groups, such as the Kutenai Indians who resided in the Rocky Mountain Trench, were reported to have made numerous journeys into the Kootenay Plains each year to hunt bison and trade. Use by other Indigenous groups have also been recorded in the area (Environmental Protection 1995). Most of the recorded archaeological sites have been related to the exploitation of the wildlife resources of the Kootenay Plains. These sites include small hunting and fishing camps and stone tool workshops.

Overall, the archaeological sites in the area represent the remains of numerous prehistoric hunting and gathering cultures that have frequented the area for the past 12 000 years or more. Portions of the Reserve is thought to have been “Ice Free” during the terminal stages of the last ice age. This is believed to have allowed the first Albertans to move from the Bering Staits/Yukon area to the southern plains. Consequently, it is believed that this area may contain some of the earliest evidence of human activity on the continent, south of the Alaska/Yukon area (Environmental Protection

1995).

Environmental Protection (1995) believe that the grasslands were most likely larger in prehistoric times. These grasslands would have been suitable for prehistoric occupation. Thus, the possibility that the Kootenay Plains Ecological Reserve contains numerous undiscovered archaeological sites is high. These sites most likely exist in sheltered locales in close proximity to fresh water and high benches that provide a view of the valley.

Site specific archaeological investigations are currently conducted in conjunction with the referral process for petroleum development applications (D. Wetzel pers. comm.).

4.4 Significant Flora

Relatively few rare or otherwise significant plant species not previously described in other surveys, were observed in Kootenay Plains Ecological Reserve during the course of fieldwork for the biophysical inventory in August 1995. This does not mean that other rare plant species do not occur within the ecological reserve. Factors influencing the detection of rare plant species include, among others, the timing of the survey in relation to plant species' phenology. As well, species may be evident in one year but not another due to drought or other climatic factors. Successful identification of rare plant populations is best accomplished through intensive survey methods designed to achieve this purpose. The biophysical survey methodology employed, and the relatively low sampling intensity attained during 1995 fieldwork, reduced the chances of success in locating rare plant populations within the ecological reserve. In contrast, Wallis and Wershler (1981) located many rare plant species in the same study area during the course of a study specifically intended to provide a flora and grassland assessment of the Kootenay Plains. A current rare plant survey of Kootenay Plains has also been conducted by Geographic Dynamics Corporation and is currently in press (1997). A species list of rare flora, as defined by Packer and Bradley (1984), Wallis et al (1987) and

Wallis and Wershler (1981), as well as uncommon and disjunct plants identified in the Kootenay Plains Ecological Reserve is presented in Appendix 4.

4.5 Significant Fauna

For the purpose of this report, wildlife species will be considered as significant if they have:

- been designated as such by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
- been designated as such by Alberta Fish and Wildlife Services;
- been cited as being locally rare or uncommon in the province; or
- been cited as being of relatively high abundance in the Kootenay Plains Ecological Reserve.

COSEWIC determines the national status of wild species, sub-species, and separate populations in Canada. All native fish, amphibians, reptiles, birds and mammals are included while invertebrate animals are not. COSEWIC has identified five risk categories for Canadian wildlife species, as follows (COSEWIC 1995):

Extinct - a species formerly indigenous to Canada that no longer exists anywhere

Extirpated - a species no longer existing in the wild in Canada but existing elsewhere

Endangered - a species threatened with imminent extinction or extirpation throughout all or a significant portion of its Canadian range

Threatened - a species likely to become endangered in Canada if the factors affecting its vulnerability are not reversed

Vulnerable - a species particularly at risk because of low or declining populations, small

range, or for some other reason, but not a threatened species

Provincial populations of wildlife species in Alberta have also been evaluated by Alberta Fish and Wildlife Services (Alberta Fish and Wildlife Division 1991) and their status has been determined and classified as follows:

> **Red** - species whose populations are nonviable or at immediate risk of declining to nonviable levels in Alberta. They have, or will be considered for, designation as Endangered Species in Alberta.
>
> **Blue** - species which are also at risk but the threats that they face are less immediate. Particularly vulnerable to non-cyclical declines in population or habitat, or to reductions in provincial populations.
>
> **Yellow** - sensitive species which are not at risk. They may require special management to address concerns related to low natural populations, limited provincial distribution, or particular biological characteristics.
>
> **Green** - species not considered to be at risk. Their populations are healthy and often widespread and key habitats are generally secure.

Based on the aforementioned criteria, the following species or species assemblages have been identified as being significant in the Kootenay Plains Ecological Reserve.

4.5.1 Fish

The surface water drainage regime of the Rocky Mountain Natural Region is characterized by a nested, heirarchical network and ranges from small headwater types to mid-size streams, and ultimately to large rivers such as the North Saskatchewan, which, though not included the Kootenay Plains Ecological Reserve, is vital to fauna utilizing the area. The North Saskatchewan River, and all of its major tributaries, are glacial in origin (Tebby 1974a, 1974b) making them largely cold waters. The variance in hydrological regimes in and around the Kootenay Plains Ecological Reserve

provides the region's watercourses with a diverse complement of fish species.

As with terrestrial wildlife species, species diversity of fishes is directly related to a heterogeneity of habitats. Diversity of fish species is maximized in long watercourses that provide heterogenous habitats horizontally, or along the river or stream gradient. As has been described by Bayley and Li (1992), streams can be generally subdivided into two major subsystems connected by a transition zone. The upper zone, called the rhithron, is characterized as being shaded, small, steep, swift, rocky, highly oxygenated, and cold. This zone houses coldwater fishes with high metabolic rates. They feed on ingressed food sources such as aquatic insect drift. Allochthonous input to the stream at these upper reaches is critical due to the riparian canopy which limits primary productivity. In contrast to the rhithron, the lower zone, also called the *potamon*, is large, exposed to sunlight, of low gradient, sluggish, composed of smaller substrate, lower in dissolved oxygen, and warm. Fishes which inhabit this zone are generally warmwater species with low metabolic rates and a more diverse diet. Piscivorous, herbivorous, and detrivorous fish are more common in the potoman than in the rhithron. The transition zone between the rhithron and the potoman is composed of a mixture of both types of fish assemblages as well as coolwater transitional forms.

The freshwater systems in the Kootenay Plains Ecological Reserve study area support six forms of salmonid species, including mountain whitefish (*Prosopium williamsoni*), lake trout (*Salvelinus namaycush*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), cutthroat trout (*Salmo clarkii*), and rainbow trout (*Salmo gairdneri*). Three species of catostomids [longnose sucker (*Catostomus catostomus*), white sucker (*Catostomus commersoni*), and mountain sucker (*Catostomus platyrhynchus*)], two cyprinids [longnose dace (*Rhinichthys cataractae*) and lake chub (*Couesius plumbeus*)] and one cottid, the spoonhead sculpin (*Cottus ricei*), have also been described from the Abraham Lake drainage. It must be noted, however, that not all of these species are indigenous to the North Saskatchewan drainage. Cutthroat trout were introduced to the drainage in 1929, rainbow trout in 1934, brook trout in 1941, and brown trout in 1948. As a matter of fact,

Tebby (1974a) reported the poisoning of water bodies above Abraham Lake (reservoir) in order to remove non-sport species prior to the stocking of trout for angling purposes.

The salmonids are a group of fishes adapted to the variable habitats of north temperate, recently deglaciated regions. In response to their harsh environment, they display remarkable plasticity in their habitat use. Despite this apparent adaptability, salmonids are highly sensitive to local environmental conditions and have strict requirements relating to spawning and feeding. In general, salmonids require cool, well-oxygenated water, a clean gravel substrate, and abundant cover and shade. They are much more demanding in this respect than some of the other "coarse" (Northcote 1974) fish species such as suckers and dace. Many salmonids are stressed to the point of mortality under conditions of increased temperatures or decreased oxygen levels whereas suckers can tolerate such environmental fluctuations (Nelson and Paetz 1992). In addition, many coarse fish forage mainly by smell or feel while salmonids are much more dependant upon sight, necessitating the need for clear waters. These and many other factors combine to make salmonids much more sensitive than other groups of fishes to environmental changes and, thus, renders the recognition of their habitats in the Kootenay Plains Ecological Reserve a critical step towards maintenance of these species in the headwaters of the Rocky Mountain Natural Region.

Specific ecological requirements for fish species, even within the salmonid family, vary with species. However, the major determinants of productivity can be generally applied to all Alberta fish species and they include food availability, temperature, and oxygenation levels. Specific conditions required for successful spawning, developing and hatching of eggs, fry survival, and swim-up are all totally dependant upon the physical and chemical nature of the environment. Additionally, all of the fish's physiological functions have a certain temperature range within which they will function normally (Table 2).

Dissolved oxygen and water temperature are the primary determinants of spawning success and juvenile survival for many fish species, however, dissolved oxygen requirements and temperature tolerances of fish species vary according to season, age, health, and stage of the life cycle (EPA 1990). As a result, environmental perturbations are likely to affect coldwater and transitional coolwater fishes through a wide array of impacts, including changes in turbidity and velocity, stream substrate, water temperatures, dissolved oxygen levels and biological oxygen demands, and forage sources. Of the numerous species indigenous to Rocky Mountain and foothill habitats, a few species warrant considerably more attention than others, due either to their status and sensitivity, their ecological role, or their economic or commercial importance.

Neither the federal list of vulnerable, threatened, or endangered species (COSEWIC 1995) nor the provincial Wildlife Act of Alberta recognizes any Rocky Mountain or foothills fish species to be in an imperiled state. However, the fish species of primary management concern in Alberta is undoubtedly the bull trout. Although not currently assigned any designation, it is widely acknowledged that there has been a significant decline in the species' distribution and population throughout its North American range over the past 25-30 years (Boag 1987, Roberts 1987, Alberta Fish and Wildlife Division 1990a, Rieman and McIntyre 1993). The bull trout, or bull char, is indigenous to east-slope streams of the Rocky Mountains, extending from the South Saskatchewan River drainage in the south to the Peace in the north (Nelson and Paetz 1992). Due largely to overfishing and the impoundment of east slope streams, the bull trout is now rare or extirpated from

much of its former range in the downstream reaches of rivers in the prairie and parkland regions.

Table 2: Temperature Criteria for Selected Fish Species of the Rocky Mountain and Foothills Natural Regions, Alberta [1]

	LIFE STAGE			
SPECIES	**Spawning (°C)[2]**	**Incubation (°C)[2]**	**Adult (°C)[3]**	**Fry (°C)[3]**
Rainbow trout	5 - 10	7 - 14	12 - 19	12 - 19
Cutthroat trout	7 - 10	7 - 12	12 - 19	12 - 19
Bull trout	1 - 9	1 - 7	12 - 15	12 - 15
Mountain whitefish	1 - 6	1 - 6	8 - 18	8 - 18

1. Data summarized from Taylor and Barton (1992) and from sources cited in D.A. Westworth and Associates Ltd. (1992)
2. Temperature ranges for successful spawning and incubation are presented as daily minimum and daily maximum temperatures endurable for the entire spawning and incubation periods
3. Temperature ranges for adult and fry survival are presented as daily minimum and daily maximum chronic temperatures. Refer to Taylor and Barton (1992) for a detailed explanation of chronic and acute temperature requirements of selected Alberta fish species.

While numerous lower and middle order streams and creeks house a seemingly abundant population of bull trout in the Foothills Natural Region, ESAs which designate significant bull trout habitat in the Region are critical to ensure the future recolonization of downstream habitats. Roberts (1991) states that *"there is already sufficient evidence that prairie populations of the Bull Trout are clearly endangered"* and recolonization sources are present only in upstream reaches of foothills streams. Alberta Fish and Wildlife Division (1990a) reports that the species is *"not in immediate danger of extinction but could easily disappear from some of our lakes and streams. Many populations are unable to maintain current numbers and will continue to diminish unless managed wisely."*

Biological data concerning the ecological requirements of bull trout are relatively scarce in the

literature due to the fact that the species has only recently been taxonomically differentiated from the coastal dolly varden (*Salvelinus malmo*) (Haas and McPhail 1991); prior to 1978, bull trout was generally considered conspecific with dolly varden (Boag 1987). Bull trout are thought to have more specific habitat requirements than other salmonids (Rieman and McIntyre 1993). Channel and hydrologic stability, substrate, cover, temperature, and the presence of migration corridors consistently appear to influence bull trout distribution and abundance (Alberta Fish and Wildlife Division 1985, Ziller 1992). Shepard et al. (1984) found bull trout occurred most frequently in third and fourth order streams, however spawning and rearing activity is often limited to smaller watersheds and their tributaries.

Temperatures in excess of 15-18°C are thought to be limiting to bull trout production (Alberta Fish and Wildlife Division 1990a, D.A. Westworth and Associates 1992, Newbury and Gaboury 1993). These researchers recognized temperature more consistently than other factors influencing bull trout distribution in Alberta and throughout its range. Therefore, spawning areas have been characterized as being associated with the coldest streams in a basin. Some research has suggested that bull trout grow more quickly in cold waters than in warm waters; however this contention is contradicted by some historical Alberta accounts of large adults occurring in cool waters in prairie and parkland habitats (Roberts 1991). Nonetheless, the largest bull trout recorded for Alberta, weighing 11.7 kg, was taken from the colder waters of the Muskeg River in 1947 (Alberta Fish and Wildlife Division 1990a).

Habitat complexity is an important component of the natural environment for viable populations of bull trout. Bull trout usually associate with complex forms of cover. Juveniles live close to in-channel wood, substrate, or undercut banks; young-of-the-year use side channels, stream margins, and other areas of low velocity; and older fish utilize pools and areas with large or complex woody debris (Pratt 1992). Cover is especially important in providing overwintering sites and is thought to limit many fish populations. Rieman and McIntyre (1993) have pooled the knowledge of a wealth

of researchers and concluded that strong bull trout populations will require high stream channel complexity. Channel complexity provides cover and contributes to the growth, survival, and stability of other salmonid populations as well, thus providing a critical resource for the often times piscivorous bull trout. A combination of unique habitat requirements and intrinsic biological constraints can be identified as being the primary limiting factors to bull trout in the Rocky Mountain Natural Region at present. Such factors include (Alberta Fish and Wildlife Division 1990, Rieman and McIntyre 1993):

1. Bull trout require cold, clean, groundwater-fed streams; such high altitude headwaters are areally limited in Alberta.

2. Spawning and nursery streams are cold and small, providing very little in the way of food, space, and shelter. These stream characteristics limit the number of fingerlings that can be supported, even after successful spawning.

3. Overwintering occurs in deep pools or in association with large woody debris, both structural features that are limited in number and capable of supporting only a small number of fish.

4. Reproductive potential of bull trout is naturally low and the fish mature slowly, often reaching spawning age in their fifth of sixth year. In addition, some female bull trout do not spawn in consecutive years.

Temporal and spatial patterns of bull trout populations in Alberta are not known. A similar dearth of information characterized the current state of knowledge concerning rates of dispersal of bull trout. However, the importance of connections and interactions among local populations is well supported by theory (Levins 1970) and by observations from other species. Numerous streams in the Kootenay Plains Ecological Reserve, for example, contain various combinations of critical spawning, rearing, and overwintering habitat for bull trout and all form a significant proportion of the North Saskatchewan River and Abraham Lake drainage system. It is feasible that bull trout populations within these creeks of various orders may interact with each other and immigrate and emigrate between populations. Bull trout are currently managed as a sportfish in Alberta and

existing sportfishing regulations enforce a province-wide catch limit of two. However, recent concerns over the provincial status of bull trout has resulted in a reconsideration of the species' management and potential designation as a species of special concern. In an attempt to further the understanding and recognition of the species, a provincial Bull Trout Task Force has been organized and a Bull Trout Management and Recovery Plan (Berry 1994) prepared. Included in that document are considerations to reduce the catch limit to zero and to enforce seasonal, permanent, and all-year closures above and beyond those presently in place.

The species richness of fisheries in a catchment basin reflect its zoogeographic history and the conditions of its watershed. Watershed condition affects the composition of fishes from the available species pool simply because *water flows downhill.* Therefore, disturbances at the top of the watershed can affect water quality and habitat suitability throughout the catchment downstream. Rivers and streams must be managed as integrated, flowing systems. Within a drainage basin, flow habitats are nested within one another at smaller and smaller scales. While quality micro-habitats are essential for individual fishes and, ultimately, to fish populations, it is critical for designated significant fish habitats to be large enough to accommodate local spawning migrations within the watershed for species such as bull trout.

4.5.2 Reptiles and Amphibians

The herpetofauna of Alberta includes a diverse mixture of species with southern and eastern affinities. It is not surprising, then, that the greatest concentration of amphibians and reptiles occurs in the arid southeastern corner of the province. Only two species have been identified from the high-elevation habitats found in the Kootenay Plains Ecological Reserve study area - the spotted frog (*Rana pretiosa*) and the western toad (*Bufo boreas*) (Wallis and Wershler 1981). Russell and Bauer (1993) also indicate these two species as the only Alberta herpetiles whose range includes the Kootenay Plains Ecological Reserve itself, however they do show wood frog (*Rana sylvatica*) as

being collected from areas adjacent to Abraham Lake. None of these species is designated by COSEWIC or by Alberta Fish and Wildlife Services as being at immediate risk.

The parameters of temperature and water availability are the most important factors determining habitat use and suitability for amphibians and reptiles. By placing stresses on physiology and breeding activity, these abiotic factors are primary determinants of distribution, relegating biotic features such as food availability and predator density to secondary determinants. Spotted frogs and western toads have habitat preferences for cooler waters and they are representatives of montane groups that occupy high elevation habitats throughout western North America. Within high-elevation habitats such as Kootenay Plains Ecological Reserve, several aquatic habitat types, differing in water temperature, depth, permanence, and flow rate, can occur and the specific distributions of these amphibians are determined by such micro-habitat variations.

These two species differ in their micro-habitat requirements as western toads are largely terrestrial, burrowing into loose soil or existing burrows of small mammals. Conversely, spotted frogs are highly aquatic and are usually found associated with permanent water. Both species have been identified around the margins of Abraham Lake and wetlands within the Ecological Reserve (Wallis and Wershler 1981, Russell and Bauer 1993), giving an indication of the high diversity of micro-habitats that are provided in a small area of this region.

4.5.3 Birds

Researchers have long hypothesized that a correlation existed between certain habitat features and components of an area's breeding avifauna (MacArthur and MacArthur 1961). This concept has been accepted and built upon by modern conservation biologists, who now widely recognize that the distribution and abundance patterns of avifauna species reflect the composition and structure of vegetation or habitat communities (Hunter 1990). Although no systematic survey of avifauna has

been conducted in the Kootenay Plains Ecological Reserve, Wallis and Wershler (1981) identified 65 species which may potentially occur in the area, 44 of which are potential resident breeders.

Avifauna in Alberta exhibit a diversity of ecological profiles, as exemplified by Smith (1993). The physiographic variation within the area of the Kootenay Plains results in its avian inhabitants displaying considerable variation in migratory patterns (permanent residents, short distance migrants, and long distance migrants); foraging guilds (granivores, insectivores, and carnivores); and nest site selection (cavity nesters, ground nester, and brood parasites). Complexity, both of the forest strata and of the forest mosaic, is the key to diversity of avian community structure in Kootenay Plains Ecological Reserve. Vertical and horizontal heterogeneity (Hunter 1990) provide differentiated and stratified niches and a relatively large accumulation of biomass which, in turn, supports a diverse food web (Saxena et al. 1994). As a result, the area's avifauna includes habitat generalists such as American robin (*Turdus migratorius*) and northern flicker (*Colaptes auratus*) as well as open grassland specialists such as vesper sparrow (*Pooecetes gramineus*) and forest-interior specialists such as pileated woodpecker (*Dryocopus pileatus*). Species guilds present in the area are also diverse, including passerines (perching birds) and non-game birds, waterfowl and upland game birds, and raptors.

4.5.3.1 Non-game Birds

Traditional habitat management has focused on the perpetuation of harvestable game species. This historical emphasis on waterfowl as gamebirds, for example, has resulted in a relative lack of attention being placed on non-game birds. Non-game birds are a heterogenous group, distinguished more by a process of elimination rather than by a precise statement of definition; basically, they include all of those species that are not hunted for food or sport (Kroodsma 1979). For purposes of identifying critical non-game avifauna habitats in the Kootenay Plains area, non-game birds are identified here as the neotropical migrant landbirds, or those that breed in the nearctic and migrate

south to the neotropics of the southern hemisphere and those that breed in the arctic and migrate to non-neotropical areas of southern continental North America.

Declining trends of songbird populations have largely been described for agriculturally dominated landscapes in the eastern United States, where habitat fragmentation has been proposed as a primary contributor to species loss. Fundamental differences between fragmentation patterns in eastern North America and those currently shaping western landscapes have rendered comparisons between the two processes difficult. Nonetheless, the habitat characteristics related to fragmentation are relevant to western songbirds and to neotropical migrants indigenous to the Rocky Mountain Natural Region in Alberta.

These species are of particular concern and have experienced drastic population declines due, in large part, to a documented deforestation problem on their tropical wintering habitats (for reviews concerning the impacts of tropical deforestation on neotropical songbirds, see Diamond 1991, Robbins et al. 1992, Thiollay 1992, Petit et al. 1993). Diamond (1988, cited in Sweetgrass Consultants Ltd. 1994) cites an extremely high rate of expected losses of winter habitats for many species indigenous to the Rocky Mountains and associated foothills (Table 3). While tropical deforestation of winter habitats has been implicated as a major cause of declining songbird populations, fragmentation of breeding habitat in temperate regions of North America has also contributed cumulatively to the declining population trends.

Size, extent, and structure of habitat patches are critical factors which determine use of appropriate habitats by various avifauna species. Fragmentation of large tracts of forest inherently produces ecological edges, or ecotones, which have been shown to adversely affect forest interior species such as winter wren (*Troglodytes troglodytes*) and ovenbird (*Seiurus aurocapillus*). It is axiomatic that many game species are more abundant near edges. Harris (1988) contends that wildlife managers have traditionally been taught that "edge" was good for wildlife and, in many cases, wildlife

management was considered synonymous with creating edge habitat. While certain species thrive in edge habitats, increased nest predation and parasitism have also been documented at forest edges (Brittingham and Temple 1983, Yahner and Scott 1988, Hannon 1993) and have negatively impacted forest interior species.

Parasitism by the brown-headed cowbird (*Molothrus ater*) has been recently characterized by Robinson et al. (1993) as one of the major threats to populations of neotropical migrants on temperate breeding grounds. The brown-headed cowbird is a generalist brood parasite and Friedmann and Kiff (1985) describe 240 separate host species in whose nests cowbirds will lay their eggs. Cowbirds are attracted to forest edges in both natural and anthropogenic clearings throughout their range. Cowbird nesting records have been noted for the area around Kootenay Plains Ecological Reserve, particularly the North Saskatchewan River valley, Abraham Lake shoreline, and south and east of the White Goat Wilderness Area (Semenchuk 1992).

Table 3: Expected Loss of Winter Habitat of Selected Songbirds Indigenous to the Kootenay Plains area (adapted from Sweetgrass Consultants Ltd. 1994)

SPECIES	EXPECTED LOSS OF WINTER HABITAT (%)
Philadelphia vireo	83
Orange-crowned warbler	63
Yellow-bellied flycatcher	60
Northern oriole	52
Yellow-rumped warbler	45
Yellow-bellied sapsucker	40
Olive-sided flycatcher	39
Solitary vireo	30
Swainson's thrush	26

Cowbird parasitism drastically reduces host nest productivity for the following reasons (Roskaft et al. 1990, Sealy 1992):

1. female cowbirds often remove at least one host egg from the parasitized nest;
2. cowbird eggs are unusually thick and, when laid, often break those of the host;
3. cowbird eggs have a shorter incubation period than most host eggs;
4. cowbirds usually parasitize hosts smaller than themselves, giving cowbird nestlings a competitive advantage over host nestlings.

Graham (1989) describes the brown-headed cowbird as having undergone one of the greatest range expansions of any North American bird species in the past 200 years. Large scale landscape changes during the same period has allowed for such an expansion, as cowbirds are frequently associated with agriculture, human settlements, and internal and external edges. Most ecologists today (Robinson et al. 1993, for example) argue that the most efficient method of reducing cowbird impacts on neotropical migrants is through landscape-level management aimed at maintaining large areas of contiguous forested habitat. The minimum area thought to be required to retain local populations of forest songbirds varies considerably in the literature, ranging from as small as 3,000 ha (Robbins et al. 1989) to areas as large as 50,000 ha (Biological Advisory Team 1990).

A quantitative loss of habitat is the most noticeable impact of forest fragmentation throughout forested ecosystems. However, qualitative changes in the remaining forest fragments are anticipated to be of greater concern for many neotropical migrants breeding in the Rocky Mountain Natural Region since most of these species utilize small territories. Higher rates of brood parasitism by brown-headed cowbirds, as discussed above, has already been documented as a major qualitative impact of fragmentation. Other documented qualitative mechanisms responsible for changes in forest songbird populations as a result of forest fragmentation include increased rates of interspecific competition (Ambuel and Temple 1983), reductions in pairing success (Villard et al. 1992), and reductions in nesting success (Hoover 1992).

Arguedes (1992) and Faaborg et al. (1993) suggest that neotropical migrants might be the vertebrate group least sensitive to isolation of fragments due to their long distance travel capabilities. Such contentions, however, do not preclude the need to adequately conserve large areas of contiguous forested land for songbirds. Villard et al. (1992) provide some evidence that forest bird populations function as metapopulations within landscapes. Therefore, effective conservation of neotropical songbirds may require the preservation of suitable but intermittently unoccupied habitat (Freemark et al. 1993). The identification of a broad range of significant features in this and other reports,

including creekside woodland and fen complexes, grassland meadows and communities, coniferous forest stands, and tall riparian poplar and willow communities, acknowledge the diversity of landscapes and habitats utilized by many passerines in the vicinity of the Kootenay Plains Ecological Reserve.

4.5.3.2 Raptors

The generic name applied to this group of predatory birds is intended in this report to include both *Falconiformes* and *Strigiformes* Orders. Based on geographic distributions identified by Salt and Salt (1976) and Semenchuk (1992), eight species of eagles, hawks, falcons, and owls are anticipated to utilize habitats in the Kootenay Plains Ecological Reserve to some extent. Some of these species are wide-ranging habitat generalists which are common throughout most of Alberta, including red-tailed hawk (*Buteo jamaicensis*) and great horned owl (*Bubo virginianus*). Other species are habitat specialists that are dependent upon unique structural features of forested habitats and grassland habitats; examples include the osprey (*Pandion haliaetus*) and bald eagle (*Haliaeetus leucocephalus*) in forested regions of the study area and northern harrier (*Circus cyaneus*) in grasslands and meadows of the study area. Still other species such as great gray owl and Cooper's hawk (*Accipiter cooperii*) are federally designated by COSEWIC as vulnerable species (COSEWIC 1995). Among the resident raptors, the great gray owl reaches the western (and altitudinal) limit of its range in the study area while bald eagle and osprey are among the most abundant species.

The bald eagle, North America's largest broad-winged raptor, represents a unique conservation and management challenge to both resource planners and land users. Formerly ranging across large portions of North America, this species is now considered vulnerable in most of the continental United States and, although not afforded any formal designation, is considered a species at risk throughout much of its Canadian ranges. It formerly nested throughout Alberta but breeding is now restricted largely to northern portions of the province while overwintering is reported from areas in

southern Alberta (Semenchuk 1992). While the exact status of bald eagles in Alberta is not known, the species has been blue-listed by the Alberta Fish and Wildlife Division (1991). Certain aspects of the bald eagle's ecological relationship with its environment have rendered it a sensitive species and warrant its active management.

Habitat requirements for nesting bald eagles have been identified by various authors as including the proximity of a large body of water (an inland lake or river), suitable tall trees near shore for nesting and roosting, good fish populations, and relatively little human disturbance (Gerrard 1983, Semenchuk 1992). Viability of bald eagle populations is dependent upon two factors, natural habitat components and human disturbance levels. Bald eagles have traditionally been regarded as largely piscivorous, however, ecological studies of bald eagle foraging habits have revealed widely varying diets consisting mostly of seabirds (DeGrange and Nelson 1982), waterfowl (Cash et al. 1985, Saxena et al. 1994), and small mammals (Sherrod et al. 1975, Smith 1986). In actuality, bald eagle prey selection is determined largely by availability. Many researchers have found that, in response to habitat differences and prey availability, bald eagles will readily abandon a seasonally primary prey item in favor of prey which becomes more readily available. Griffin et al. (1982), for example, reported that bald eagles in Missouri neglected their primary prey, crippled or moulting waterfowl, in favor of fish during the years of heavy fish kill.

Eagles prefer nest sites of relative solitude and human disturbances can be very disruptive to breeding success, in some cases leading to nest and hatchling desertion. The impact of anthropogenic behavioural changes in bald eagles is a conservation dilemma. Several studies have shown that raptors flush at the approach of humans and this is particularly well-documented for bald eagles. Russell (1980), Skagen (1980), and Knight and Knight (1984) quantified the responses of wintering bald eagles to boating activity. Flight disturbances of perched eagles were highest for human disturbances originating from the water and on gravel bars, intermediate for land-based disturbances, and shortest when disturbances were shielded by vegetation.

Because disturbance can cause adult birds to flush from their nest, human activity can alter parental nest attentiveness, thus disrupting feeding patterns and increasing egg or nestling mortality. In a related anthropogenic disturbance study, White and Thurow (1985) reported that territories containing disturbance - free control nests were reoccupied 40 percent more frequently than those containing disturbed nesting sites. Additionally, disturbed nests that were not deserted fledged significantly fewer young than undisturbed nests.

Despite the wealth of information in the literature pertaining to the high degree of sensitivity of bald eagles to disturbances, considerable ambiguity remains concerning the impacts of such disturbances on the productivity of nest sites. The fact that eagles prefer to nest in areas with little or no human disturbance cannot be denied and is substantiated by numerous quantitative studies on bald eagle nesting habits. However, nesting eagles have also been shown to be tolerant of low degrees of human disturbances and to respond to high degrees of disturbance by relocating nests within the same area (Lehman et al. 980, Jaffee 1980, Taylor and Therres 1981, Hodges et al. 1984). As early as 1924, Herrick described bald eagles, stating that "*it would be hard to find greater adaptability among the diurnal birds of prey than that exhibited by Bald Eagles*."

The ambivalence of data pertaining to disturbance of bald eagle nest sites creates a management quandary for land users in and around waterbodies with resident nesting bald eagles. While it remains true that extreme levels of tolerance and adaptability have been recorded, previous records of nest, and even range, desertion as a result of human activity must take precedence as a grounds for management in the absence of site-specific data. The North Saskatchewan River and the Siffleur River provide excellent bald eagle nesting sites while numerous bald eagles also inhabit the banks of Abraham Lake.

Ospreys are widespread in appropriate habitats throughout Alberta, yet their fluctuating numbers (over their North American range) as well as their trophic position atop the food chain render the

species particularly sensitive to disturbances and to environmental perturbations. The historical status of osprey in Canada has been a very different story than that of osprey inhabiting the United States. While numbers in Canada are generally thought to have remained stable since the turn of the century, osprey populations in the eastern United States were drastically affected by the introduction and widespread use of organochlorine pesticides such as DDT. Production of osprey nest sites dropped to as much as five percent of former levels in some areas (Canadian Wildlife Service 1984). Like the bald eagle, osprey are ***blue-listed*** by Alberta Fish and Wildlife Division (1991), implying that they are particularly vulnerable to population fluctuations or to habitat destruction.

Osprey are anticipated to occur on or around any body of water where fish, their primary food source, are readily available. In describing osprey foraging sites, many researchers have stressed the importance of clear, unobstructed, shallow waters (Postupalsky 1978, Prevost 1983) and the reduced success of foraging by ospreys due to extensive emergent and submergent vegetation (Prevost 1983), overhanging vegetation along shorelines of rivers and lakes (Hynes 1970), and waters that are heavily shaded or turbid (Flook and Forbes 1983), all of which reduce prey visibility for foraging ospreys.

Abraham Lake (reservoir) and associated drainages (North Saskatchewan, Siffleur, and Cline Rivers) house numerous osprey nests both on natural and artificial structures. Characteristics of Abraham Lake, adjacent to the KPER study area, provide improved foraging conditions over most rivers and oligotrophic lakes in the region as it provides a larger percentage of still, shallow, open water with an abundant fish population and reduced turbidity. The resulting increase in water clarity and higher visibility is appealing to foraging ospreys, thus attracting nesting and breeding-aged ospreys to the KPER vicinity . Ospreys are known to consume a variety of fish species, however, the slow-swimming benthic, or bottom-feeding, fishes are particularly vulnerable to predation from above (Haywood and Ohmart 1986). Hughes (1983) also related fish size to vulnerability, as he postulated that medium to large fishes feeding near the surface were predisposed to osprey attack.

Ospreys usually choose nesting sites near or over water. Tall dead snags surrounded by water provide ideal nesting sites for ospreys but the species will also often nest in live trees with deteriorating crowns. They readily utilize nest platforms as evidenced by the osprey population at the Brazeau Reservoir further east of the study area, and will also establish nests on man-made structures such as telephone poles, transmission line towers, and chimneys (Canadian Wildlife Service 1984). Osprey are apex-nesting species and their nests, therefore are built in the tallest available structures to provide an unrestricted view of surrounding landscape. Breeding densities of ospreys have been thought to be limited by shortages of nest sites, a suggestion that has been substantiated by documented increases in breeding densities immediately following the erection of nesting platforms (Newton 1980). These artificial nesting structures are critical because they allow ospreys to exploit habitats which lack adequate nest sites but have suitable food resources and minimal human activity.

In Alberta, osprey breeding density is directly proportionate to forage supplies. Osprey densities are greater and increasing in areas such as Abraham Lake, where food resources are concentrated, predictable, and accessible. Grover (1983) has cited reservoir construction as providing improved habitat on the upper Missouri River, Montana compared to areas along the free-flowing river.

Ospreys appear to have three basic requirements for successful nesting (Canadian Wildlife Service 1984):

1. an abundant and accessible fish population,
2. a sufficiently long ice-free season to allow the completion of nesting and rearing of young, and
3. nest sites relatively free from predation and disturbance.

Some ospreys are able to nest in close proximity to human activity (see Poole 1981 and Vana-Miller 1987 for review of documented habituation of ospreys to human activity and disturbed landscapes).

However, the tolerance of ospreys to disturbances is a function of the timing, frequency and predictability of the disturbances. Sporadic human activity has been shown to negatively affect nesting success of breeding ospreys (Levenson and Koplin 1984) as alarmed adults that are repeatedly flushed from their nests risk exposure of eggs and hatchlings to predators and extreme temperatures. in researching the effects of disturbance on ospreys, numerous authors have determined a "critical distance" from the nest beyond which ospreys appear undisturbed by human activity. This distance varies from 0.2 to 1.5 km (Levenson and Koplin 1984, Vana-Miller 1987).

The great gray owl is a naturally scarce species distributed widely across appropriate forested habitats in Alberta. Great gray owls are federally listed as vulnerable (COSEWIC 1994), while the provincial population has been designated as blue-listed (Alberta Fish and Wildlife Division 1991). Distributed holarctically across boreal forests of North America and Eurasia, Duncan and Hayward (1994) attribute recent southward range expansions to the species' ability to inhabit forests other than the boreal type. The status of great gray owls in Alberta has not accurately been determined to date, however, Nero (1979) estimated the North American population at 50,000 birds.

Studies of habitat use by great gray owls throughout their range have shown the species to be multitypic in its habitat requirements (Bull and Henjum 1990, Duncan 1992, Habeck 1994). Great gray owls nest in forested habitats and exhibit a preference for mature and older forest stands. The sheer size of these birds necessitates the need for large nests, large broken-top snags, or large trees with mistle-toe clumps; such nesting structures are most commonly associated with old-growth forests. In addition, the tendency of fledglings to leave the nest before they can fly contributes to the significance of forested habitat around the nest site and is considered critical for fledgling survival (Franklin 1987). Conversely, several authors cite foraging habitat as relatively open, grassy habitat, including bogs, selectively and clear-cut logged areas, natural meadows, and open forests (Nero 1980, Winter 1986). These authors, and other, maintain that, although they require isolated, forested areas for nesting, great gray owls avoid hunting in these timbered stands, preferring forest

margins. Bull and Henjum (1990) reported the majority of foraging in stands with 11 - 59 percent canopy closure where ground cover is dominated by grasses.

Numerous intrinsic biological and ecological characteristics of great gray owls render the species vulnerable or potentially sensitive to some land-use practices. Great gray owls do not build nests but, rather, rely on previous nests of nest-building species (*Accipitridae* and *Corvidae*) and on tree-pathogen / insect interactions that can influence tree branching. However, they have also been shown to readily accept artificial nesting structures (Bull and Henjum 1990) and to nest, albeit rarely, on the ground and in rock cliffs or haystacks (Duncan 1992). This flexibility has prompted some to suggest that the actual nesting structures may be relatively unimportant in nest site selection compared to the nest site habitat and the availability of adjacent foraging habitat.

The diet of great gray owls consists primarily of small mammals and microtine voles are the dominant prey item (Bull and Henjum 1990, Duncan 1992, Semenchuk 1992). Since microtines undergo dramatic, geographically asynchronous population fluctuations, movements of great gray owls are largely influenced by the dynamics of prey populations, particularly in the northern portions of their range. Food supply dictates great gray owl home ranges (Mikkola 1981), as nomadism is a common phenomenon in situations where food sources are either unpredictable or scarce. While home ranges have been reported to be relatively small, 1.3 - 6.5 km^2 (Bull and Henjum 1990), great gray owls use significantly large areas of forest landscapes. Overlapping home ranges are common, as several studies have shown numerous pairs of great gray owls inhabiting the area of single home range. Such behaviour has prompted some to classify the great gray owl as a "loose colonial nester" (Mikkola 1983, Duncan 1987).

Although many factors influence population viability of great gray owls, prey availability is thought to be a primary factor (Duncan 1992). However, other data also suggest that nest site availability limits owl abundance in some areas (Duncan and Hayward 1994). Therefore, while individual

breeding ranges are small and loosely defended against conspecifics, the area required for successful breeding, rearing, and foraging is relatively large and characterized by a mosaic of forested patches with numerous openings. The large areal requirements of great gray owl populations dictate that a broad landscape perspective be applied to their conservation.

4.5.3.3 Waterfowl

In the vicinity of the Kootenay Plains Ecological Reserve, waterfowl use is limited largely to Abraham Lake, adjacent to the northern portion of the study area. Based on geographic distributions identified by Semenchuk (1992), ten species of waterfowl can be expected in this area, of which mallard (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), blue-winged teal (*Anas discors*), American wigeon (*Anas americana*), and lesser scaup (*Aythya affinis*) are classified as yellow-listed in the province (Alberta Fish and Wildlife Division 1991).

It is likely that mallard and Barrow's goldeneye (*Bucephala islandica*) are among the few species with significant nesting populations in the Kootenay Plains area. It is generally agreed that wetlands that are most attractive to nesting ducks contain a 50:50 ratio of open water to emergent vegetation. Quality nesting and escape cover for waterfowl are considered to be provided by extensive shoreline development and accompanying emergent and submergent vegetation, qualities which do not exist in the study area. Only small pothole lakes and bogs occur in the Kootenay Plains Ecological Reserve.

The provision of staging, or stop-over, habitat for migratory waterfowl is a more realistic expectation for aquatic habitats of the Kootenay Plains Ecological Reserve. Waterfowl migrate in the spring by a series of short flights that move the birds northward along large bodies of water. Abraham Lake is one of many staging sites along both autumnal and vernal migration pathways. The migration process in waterfowl has likely been studied in more detail and is better understood than any other

non-breeding waterfowl activity and the attention is well-warranted. During vernal migrations towards breeding grounds, waterfowl are involved in numerous critical life stages including pair bond formation and nutrient reserve collection. The autumnal migration to wintering grounds which occurs after the breeding period is also crucial as the birds undergo severe endrocrinological, behavioral, and morphological changes during this period, the most demanding of which is the post-breeding molt. Unlike most birds, ducks, geese, and swans share the unusual trait of a complete, simultaneous wing molt that leaves them flightless for three to five weeks during the post-breeding period. Therefore, an accurate assessment of the staging potential of Abraham Lake should be conducted through systematic surveys of waterfowl in the region. No such surveys have been carried out to date and accurate levels of significance are, therefore, based on qualitative data extrapolated to the Kootenay Plains area.

Loss of nesting habitat is a primary concern for all of the aforementioned yellow-listed waterfowl species, both in Alberta and throughout their range. Alberta Fish and Wildlife Division (1991) cites population decreases of between 30 and 40 percent for all of these species. While much of this concern stems from breeding habitats in the prairie and parkland regions of Alberta, relatively large staging sites such as Abraham Lake are regionally significant due to their rarity in the Rocky Mountain Natural Region.

4.5.4 Mammals

Mammals constitute the most well-known group of wildlife making use of the Kootenay Plains area. Wallis and Wershler (1981) identified 14 mammals in the Kootenay Plains, however potential habitat likely exists for up to 45-50 species of mammals whose geographical range includes this region. Among the mammals that may use the Kootenay Plains Ecological Reserve, the grizzly bear, woodland caribou (*Rangifer tarandus*), and wolverine have been designated by COSEWIC as vulnerable species (COSEWIC 1995). In addition, Alberta Fish and Wildlife Division (1991)

designates nine species as yellow-listed, four species as blue-listed, and one as red-listed. The sole red-listed species is the woodland caribou, which is classified as an Endangered Animal in Alberta. Ungulates and large carnivores represent a substantial proportion of the Kootenay Plains' mammalian biomass.

4.5.4.1 Ungulates

The importance of the Kootenay Plains Ecological Reserve for ungulates centers around the grazing potential of the area's grasslands. Elk, moose (*Alces alces*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), bighorn sheep (*Ovis canadensis*), and woodland caribou all inhabit the Kootenay Plains and / or surrounding area. Mountain goats (*Oreamnos americanus*) are also present at higher elevations surrounding the Ecological Reserve itself. Elk are by-far the most numerous users of the Kootenay Plains, while caribou are extra-limital in the study area but have been observed there on occassion (E. Bruns, J. Edmonds, personal communication).

The record of human activity in the Kootenay Plains area provides some insight into historical levels of use by ungulates. Compared to historic reports of big game (ungulate) abundance, present day populations appear to be relatively small and the Plains are now sustaining ungulate populations well below their biological carrying capacity. Mussell (1982) gives historical references to ungulate use in the Kootenay Plains and cites the presence of numerous bison (*Bison bison*), moose, elk, deer, and sheep. These observations come from the journals of explorer Alexander Henry, who noted in 1811 that *"Buffalo are very numerous on this plain ... moose and red deer [elk] are also plenty; jumping deer, grizzly bears, and other animals peculiar to this country are also found here"* (Coues 1897, cited in Mussell 1982). Henry and, later, John Palliser (who travelled through the valley in 1863) both made reference to several large herds of bighorn sheep feeding on the grasslands. However, overhunting of these animals in the early 1800s resulted in a steady decline of ungulate numbers; bison likely disappeared from the Kootenay Plains by 1859 and elk were extirpated from the area by 1900.

European settlers were quick to take advantage of the grazing potential of the Kootenay Plains and, around the turn of the century, horses were brought to the Plains through the Clearwater and Siffleur river valleys and ranches were established. The eventual abandonment of these ranches provided the stock for the present feral horse herd inhabiting the valley. Mussell (1982) and Snow (1977) give an indication that by the mid-1900s, feral horses were having a negative impact on the grasslands, as population control was being implemented as early as 1930.

Historical and recent observations confirm the significance of the Kootenay Plains as winter range for ungulates, particularly elk. Two sub-species of elk occur in Alberta - the Rocky Mountain elk (*C. c. nelsoni*) and the Manitoban elk (*C. c. manitobensis*), with *C. c. manitobensis* limited to sporadic locations in eastern Alberta and *C. c. nelsoni* occupying the majority of elk range in the province. The distribution of Rocky Mountain elk in Alberta, as described by Nietfeld et al. (1984) and Smith (1994), closely follows the eastern boundary of the Foothills Natural Region. Recent expansions noted by McFetridge (1985) and Pattie and Hoffman (1992) have allowed elk to colonize appropriate habitats in northwestern Alberta. Gunson (1992) estimates a late winter population of 12,840 elk on provincial lands and an additional 4,100 elk wintering in Waterton Lakes, Banff, Jasper, and Elk Island national parks. Historical elk population and management data are summarized for various regions in Alberta by Stelfox (1964), McFetridge (1985), and Smith (1985). Recent surveys conducted by Alberta Fish and Wildlife Services in the Kootenay Plains Ecological Reserve revealed fluctuating use of the area over the past few years, with 30 elk observed in the area in 1990, none in 1993 (tracks only), and 94 in 1994.

Stelfox and Stelfox (1992) rate primary elk habitat in Alberta as occuring in the Rocky Mountain Natural Region (in both the Montane and Subalpine subregions), while they rate the majority of the Foothills Natural Region as secondary habitat. Southern habitats are influenced by chinooks, creating snow-free and south-facing grasslands with adjoining coniferous cover. Populations north of the Bow River have exhibited recent declines (Gunson 1992) due to a deterioration in range

quality (forest succession) and relatively higher rates of predation, a result of a greater abundance and diversity of predators.

Because elk are widely recognized as an adaptable and opportunistic species, it is difficult to specify their habitat requirements over broad geographic areas. Elk distribution and habitat selection is determined by a combination of many factors including topography, vegetation structure, forage quality and quantity, tradition and habitual behavior, weather conditions, predators, and human activities (Morgantini and Russell 1983). However, general inferences can be made concerning elk habitat throughout their range. The primary characteristic of elk habitat is the requirement for interspersion of forage, escape, and cover resources. Foraging areas for elk are usually in the open, thermal cover is best provided by coniferous forested stands, and dense forests with well-developed understories provide optimal predator relief (Black et al. 1979). Thus, elk are an ecotonal, or 'multitype', species, favoring high contrast forest edges which provide an abundance of forage in close proximity to escape and thermal cover.

Food habits of elk in Alberta have been extensively reviewed (see Morgantini and Russell 1983, Nietfeld 1983, Fargey 1988, Fargey and Hawley 1989, Stelfox et al. 1991, Renecker and Hudson 1992). The diets of elk are extremely variable and largely dependent upon local forage availability. While Kufeld (1973) found that 159 forbs, 59 grasses, and 95 shrubs have been reported as elk forage, grasses are preferred forage for elk in Alberta throughout the year and are consumed in both succulent and dry seasons. Bluegrass (*Poa* spp.), brome (*Bromus* spp.), wheatgrass (*Agropyron* spp.), and melic grass (*Melica* spp.) are preferred species while forbs, especially wild strawberry (*Fragaria virginiana*), are also extensively utilized (Stelfox 1980). Elk forage quality has been assessed by Morgantini and Russell (1983) for various sites in the east slopes of the Rocky Mountains and they also documented a preference by elk for fescue and wheatgrass communities.

Morgantini (1979) reported the fall and winter importance of deciduous shrubs and saplings, including saskatoon berry (*Amelanchier alnifolia*), water birch (*Betula occidentalis*), and trembling aspen (*Populus tremuloides*) as elk forage in Alberta, while Stelfox (1980) added other browse species such as willow (*Salix* spp.), rose (*Rosa* sp.), red-osier dogwood (*Cornus stolonifera*), dwarf birch (*Betula glandulosa*), and low-bush cranberry (*Viburnum edule*) which provide critical winter forage.

Morgantini and Russell (1983) describe habitat selection by ungulates as being a complex behavioral response to environmental factors. Therefore, while habitat selection by elk is largely determined by the floral composition of an area, the overall habitat utilization by elk will also reflect the species' size, morphology, food habits, social organization, and anti-predator strategy (Leuthold 1977, Morgantini and Russell 1983). The dependence of elk and other ungulates on seasonally variable food sources has necessitated adaptations to foraging in such variable northern environments, the most notorious parameter of which is snow depth and condition.

Snow depth and condition are major determining factors of elk diets on winter ranges. Skovlin (1982) refers to snow depth as the factor most limiting to elk distribution and movement, as snow depths of 41 to 71 cm have caused elk to switch from grazing to browsing and depths of 76 cm are considered detrimental for travel (Nietfeld et al. 1984). In response to variable environmental conditions, elk exhibit two very different strategies in their habitat selection and subsequent movements. The first involves a year round stationary home range while the other has developed into a migratory pattern linking the winter, intermediate, and summer ranges together. Adams (1982) and Morgantini and Russell (1983) report that elk in the Rocky Mountain east slopes have migration routes that generally follow the valley bottoms of main rivers. They move in a westerly direction in May through mid-June. Bull elk migrate first, followed by barren cows and, finally, cows with calves. Such spring and summer altitudinal movements are closely tied to the tracking of palatable plant phenology while the fall migration to lower altitudes is a response to snow

accumulations at higher elevations (Morgantini and Hudson 1983). Therefore, sites protected by topography or vegetation protected from strong winds, snow crusting and snow drifting are selected in winter and early spring. Within the Kootenay Plains Ecological Reserve, such sites are often found in large, linear riparian areas such as the North Saskatchewan River valley and includes adjacent grasslands and uplands. Adjacent forested areas provide mostly cover and shelter requirements while large inclusions of wet and dry meadows, riparian shrublands, and grasslands and savannahs provide most of the food resources required by elk.

Key winter ranges for bighorn sheep are also present in the Kootenay Plains study area. The ridges west of the North Saskatchewan River in the southern half of the study area and those east of Abraham Lake in the northern half of the study area have been identified by Alberta Fish and Wildlife Division (1981) as critical winter habitat for bighorn sheep. Similar areas have also been identified immediately east and north of the Kootenay Plains Ecological Reserve. Alberta is home to the largest population of Rocky Mountain bighorn sheep (*O. c. canadensis*) in the world, housing approximately four percent of the population. Alberta Fish and Wildlife Division (1991) estimates the Alberta population at 5,200 individuals, a slight decline from the 1980 estimate of 6,000 animals. Bighorn sheep are currently designated as a yellow-listed species by the provincial government (Alberta Fish and Wildlife Division 1991) and have generally maintained their populations under a strict sporthunting program.

Open vegetation communities and precipitous terrain with extensive rock outcrops are important components of bighorn sheep habitat in the Kootenay Plains Ecological Reserve. The use of open habitats near escape terrain reflects the predator-evasion strategy of bighorn sheep, where predators are detected visually and danger is communicated among sheep by visual cues. Local seasonal distribution of bighorn sheep in the Kootenay Plains study area is dependent on a variety of factors including slope, distance to escape terrain, salt availability, elevation, aspect, forest cover, shrub productivity, biomass and nitrogen content of palatable grasses, and snow accumulation and cover.

Several ecological factors combine to make winter range quality critical for the survivorship of bighorn sheep herds:

(1) If winter range becomes restricted or deteriorated, malnutrition occurs at a time when climatic conditions are the most severe.

(2) Poor winter forage may increase the incidence of lungworm disease and lamb mortality, or may cause late breeding by ewes.

(3) Sheep often must compete with other grazing ungulates that use the same range at various times of the year (Table 4).

(4) These same wintering areas are the first to green up in the spring and thus provide for the recovery of animals from poor winter forage conditions.

In areas such as the Kootenay Plains where winter ranges of ungulates overlap, elk can be serious competitors with bighorn sheep. Food habits of sheep and elk are similar in forage class composition throughout the year, although there are many differences in actual species consumed. In mild winters, elk remain in the lower valleys. However, severe weather, often coupled with over-population, can force them up to exploit exposed forage at higher elevations where the sheep are found. Stelfox (1976) found that sheep winter ranges were grazed heavily by elk during the summer.

Mussell (1982) provided a historical account of ungulate utilization of the Kootenay Plains and described considerable bighorn sheep foraging on alluvial grasslands in the river valley. Many recent studies have also been conducted in other areas which corroborate sheep preferences for open vegetation types, such as montane shrublands and windblown ridges, and avoidance of dense shrublands and forests (Arnett 1990, Cook 1990). Within the Kootenay Plains itself, Mussell (1982) found that bighorn sheep almost exclusively made use of open, wind-swept slopes and ridge tops occupied most often by limber pine stands.

Table 4: Preferred forage items of ungulates on subalpine and foothill ranges in Alberta (adapted from Wishart 1958 and Etter 1972)

(H, M, and L represent high, medium, and little or no utilization of the plant listed)

Plants Eaten	Bighorn Sheep	Elk	Mule Deer	Moose
Grasses				
Agropyron spp.	H	H	L	M
Koeleria cristata	H	M	L	L
Poa spp.	M	H	H	M
Bromus spp.	L	H	M	L
Sedges				
Carex spp.	H	M	M	M
Forbs				
Astragalus spp.	H	L	L	L
Oxytropis spp.	H	L	L	L
Hedysarum spp.	M	L	L	L
Delphinium spp.	M	L	L	L
Cirsium spp.	M	M	L	L
Shrubs and Trees				
Salix spp.	H	H	H	H
Populus tremuloides	H	H	M	H
Ribes spp.	H	L	L	L
Picea glauca	M	L	L	L
Rosa spp.	L	M	M	L

Woodland caribou are generally regarded as inhabitants of mature boreal forests with strict habitat requirements related to forage and inter-specific relationships. Dry, lichen-rich pine ridges and associated muskegs are typical caribou habitat throughout west-central Alberta while caribou habitats in northwestern Alberta are characterized by extensive muskegs and adjacent pockets of closed spruce and pine forest (Alberta Fish and Wildlife Division n.d.). The woodland caribou, as taxonomically defined by Banfield (1961), is currently designated an Endangered Animal by the provincial Wildlife Act. Alberta Fish and Wildlife Division (1991) has listed the species as ***red-listed*** due to concern over old-growth forest habitats and predation in some populations. The status

of woodland caribou throughout their Canadian range has most recently been assessed by Kelsall (1984) and the western population has been designated as vulnerable. Two ecotypes of woodland caribou occur in Alberta. The mountain-dwelling ecotype, commonly referred to as mountain caribou, occur in west-central Alberta and can be behaviorally differentiated from the boreal forest ecotype which are found throughout northern and northwestern Alberta. The distribution of caribou is discontinuous throughout west-central and northern Alberta and populations have witnessed continued declines since the turn of the century. Early provincial estimates by Stelfox (1966) of 6,860 to 9,060 and by Lynch and Pall (1973) of 4,800 to 5,200 animals are substantially higher than current estimates by Edmonds (1991) and Alberta Fish and Wildlife Services (1993) of 3,100 to 3,500 woodland caribou in Alberta. Legal and illegal harvest by humans, wolf predation, and extensive loss or alteration of winter habitat are the major causes of this decline and predation has been further implicated as the primary factor limiting the growth of caribou herds in Alberta (Edmonds and Bloomfield 1984, Edmonds and Smith 1991).

The functional relationship between caribou and forested habitats in the foothills is best defined by the provision of winter forage. Caribou winter diets are dominated by three major forage types - arboreal lichens, terrestrial lichens, and vascular plants. Seasonal use of habitats by caribou is dictated by the relative availability of these forage types which is, in turn, dependent upon nival conditions. Changes in snow depth or density may cause caribou to switch between arboreal and terrestrial forage and is one of the primary factors contributing to altitudinal migrations of caribou in rugged and mountainous terrain (Seip 1992a). Mountain caribou ecotypes in Alberta make distinct seasonal movements between alpine summer ranges and lowland, forested winter ranges, averaging a straight-line distance of 80 km between ranges (E.J. Edmonds, pers comm.).

Stand age has been identified by many researchers as a determinant of habitat quality for woodland caribou in forested habitats (Servheen and Lyon 1989, Harris 1992, Seip 1992a, 1992b). Most interpretations of caribou habitat characteristics include the presence of lichens in all seasonal

habitats except spring. Old growth stands provide abundant arboreal lichens because these epiphytes require slow-growing or decadent substrates on which to grow. Seip (1992b) and Terry (1993) documented avoidance of immature stands by caribou, suggesting that young stands do not provide suitable habitat. However, terrestrial lichens, notably reindeer lichens (*Cladina* spp.), make up the majority of caribou winter diets in Alberta. Common substrates for establishment of these lichens include tops of stumps, beds of dead feathermoss, and other decomposing organic matter. Slope and aspect have also been identified by Harris (1992) as important environmental factors regulating epiphyte growth, with *Cladina* spp. reaching their greatest abundance on dry, upper slopes and south-facing exposures.

Edmonds (1988) and Brown (1992) both reported wolf (*Canis lupus*) predation as a critical factor in the decline of caribou herds in west-central Alberta. Other carnivores such as grizzly bear, black bear (*Ursus americanus*), cougar (*Felis concolor*), coyote (*Canis latrans*), and lynx (*Lynx rufus*) are also anticipated to have a cumulative effect on these caribou populations, particularly in subalpine habitats, where the diversity of large carnivores is greater than in caribou habitat in northeastern Alberta, for example. The Kootenay Plains Ecological Reserve itself does not provide adequate habitat for caribou, however higher elevation habitats surrounding the Plains may be utilized. While individuals have been sighted in the Ecological Reserve (J. Edmonds, E. Bruns, personal communication), large herds inhabit the White Goat and Siffleur wilderness areas to the northwest and southwest of the Kootenay Plains. The valley around the Kootenay Plains is also a source of a potential multi-prey base for predators and is, therefore, not conducive to a high production rate for caribou. Although there is presently a lack of lichen-producing old growth forests in the Kootenay Plains Ecological Reserve itself, caribou movement through the area is not entirely understood. Use of portions of the Kootenay Plains area as a migratory route could be significant if emigration occurs regularly between herds in the Siffleur Wilderness Area, the White Goat Wilderness Area, and the national parks.

4.5.4.2 Other Mammals

Carnivores are important large mammals in the study area. The region's diverse ungulate population provides a wide prey base for coyotes (*Canis latrans*), timber wolf, black bear (*Ursus americanus*), grizzly bear (*U. arctos*), wolverine (*Gulo gulo*), cougar, and lynx, all of which may be found at various times of the year in the Kootenay Plains and adjacent uplands. Of these species only the grizzly bear and wolverine have been given a COSEWIC designation, both being classified as vulnerable.

Among Alberta's resident large carnivores, the grizzly bear is a species that is often used as a measure of ecosystem health. Characterized by an intrinsically low population density, low reproductive output, and a general incompatibility with anthropogenic activity, grizzly bears have been rendered sensitive to various levels of development and habitat fragmentation. The charismatic stature of the species as a symbol of wilderness has also placed it at the forefont of many resource use conflicts.

The circumpolar brown bear has historically had one of the greatest geographic distributions of any ursid; in North America, brown bears were present from central Mexico to the Arctic Ocean and from the Pacific Ocean east to the Mississippi River (McLellan 1992). However, the range of grizzly bears in North America has drastically declined to its present extent and Alaska, western and northern Canada, and the northern Rocky Mountains in the United States now house the only populations of *U. a. horribilis*. The status of grizzly bears in Canada was first evaluated by Macey (1979) for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), who concluded that the grizzly bear in Canada was not endangered or threatened but that it was "*extremely vulnerable*". Populations of grizzly bears have continued to decline as the anthropogenic factors which adversely affect grizzly bears have seen a concomitant increase during the same period.

The status of the grizzly bear in Canada was re-examined by COSEWIC in 1991 (Banci 1991) and most populations of grizzly bears, including those in Alberta, were classified as vulnerable. Within Alberta, populations in the northern interior boreal forests and west-central foothills of the province, the sub-alpine mountainous ranges of the northern Rocky Mountains, and the southern foothills and Rocky Mountains currently occupy 64, 54, and 83 percent of their potential habitat capabilities respectively (Banci 1991). Alberta Fish and Wildlife Division (1991) has designated the grizzly bear as a ***blue-listed*** species of concern in the province despite "*numbers that have remained relatively stable outside the national parks*". The loss and fragmentation of wilderness habitat is widely acknowledged as the greatest threat to grizzly bears both in Alberta and throughout their range (Horejsi 1986, Gunson and Treichel 1987, LeFranc et al. 1987, Nagy and Gunson 1990, Alberta Fish and Wildlife Division 1991, McLellan 1990a, 1990b, 1992). Historical reviews of grizzly bear distribution and management in Alberta are provided by Nielson (1975), McCrory and Heerero (1982), and Nagy and Gunson (1990).

Effective population management of grizzly bears and other wildlife species first requires reliable population data. However, grizzly bears possess intrinsic characteristics which render the species difficult to census and makes the determination of population status, trends, or rates and directions of change an equally difficult task. Even under the best conditions, grizzly bear populations exhibit very low densities. They are highly mobile, often crepuscular and secretive, and occupy extremely large home ranges. As a result, no satisfactory method of censusing grizzly bears has been developed to date. Rather, the most acceptable method available consists of formulating relationships between habitat quality and bear densities based on a limited number of detailed studies which can be used as benchmarks (for examples, see McLellan 1992, Banci 1991, Nagy and Gunson 1990). Based on such extrapolatory data, Nagy and Gunson (1990) have estimated Alberta's grizzly bear population on provincial lands to be approximately 575 individuals. In addition, grizzly bear range in Alberta, as defined by Nagy and Gunson (1990), Pattie and Hoffman (1992), and Smith (1993) corresponds closely to subalpine and foothill biomes. Protected areas such as Banff, Jasper,

and Waterton Lakes national parks, despite their enormous size and largely pristine nature, contribute an additional 215 animals to the provincial population, further emphasizing the importance of the provincially managed grizzly bear habitats occurring largely within the Rocky Mountain Natural Region and the Foothills Natural Region.

Active conservation of grizzly bears hinges on the recognition and incorporation of the species' large home ranges into any land-use management plan. While the sizes of grizzly bear home ranges have been reported to vary with sex, age, and reproductive status as well as among populations (Craighead and Mitchell 1982, LeFranc et al. 1987, Nagy and Gunson 1990), home range size is also influenced by population densities and by habitat quality. Considerable variation is evident in home ranges of grizzly bears reported in the literature. Mean annual home range sizes of grizzly bears in Alberta vary from 33 km^2 for sub-adult females in Kananaskis Country (Carr 1989), 82 km^2 for sub-adult males in the Swan Hills (Nagy and Russell 1978), and 2,755 km^2 for adult males in the Berland River area (Nagy et al. 1990). Resultantly, the grizzly bear has one of the largest home ranges of any land mammal in North America.

An important determinant of home range size is the seasonal availability and the distribution of food items. The grizzly bear is an opportunistic omnivore that feeds on a wide variety of plant and animal foods, many of which are only available seasonally. The annual feeding cycle of grizzly bears follows plant phenological patterns which are, in turn, directly related to elevation. Thus, the grizzly is an altitudinal migrant whose movements are driven by attempts to maximize energy values in preparation for a torpid winter state. Although diets vary among individual Alberta populations of grizzly bears, research in the Swan Hills (Nagy and Russell 1978), Jasper National Park (Russell et al. 1979), Banff National Park (Hamer and Herrero 1987), Waterton Lakes National Park (Wielgus 1986), Berland-Wildhay rivers (Nagy et al. 1989), and Kananaskis Country (Carr 1989) all showed similar foraging patterns and can be summarized as follows. Herbaceous vegetation such as horsetails (*Equisetum* spp.), sedges (*Carex* spp.), and graminoid grasses as well as non-native clovers

(*Trifolium hybridum, T. pratense*) are important early summer forage while feeding activity switches to berries such as buffalo berry (*Shepherdia* spp.), blueberry (*Vaccinium* spp.), and bearberry (*Arctostaphylos* spp.) in late summer and fall. However, the majority of weight gain that grizzlies obtain from vegetation comes from starchy tubers, sweet fruits from shrubs, which are rich in sugars, and cones of certain conifer species, which are high in fats (Servheen 1986). The roots of sweetvetch (*Hedysarum* spp.) provide such high quality forage throughout most of the grizzly's range in Alberta. *Hedysarum sulphurescens* is a robust legume with a large underground taproot; it is, therefore, much more accessible to the grizzly bear than to the black bear, in areas where the two species are sympatric. Grizzly bears also feed opportunistically on carrion and prey on large mammals including elk and moose as well as small mammals such as ground squirrels. Patchy food distribution and variable nature of the production of certain forage items makes these resources unpredictable in space and time. The probability of any given area having sufficient numbers of productive food patches at any one time is a function of the size of the area. Thus, it can be said that, to a certain extent, grizzly bears have compensated for resource unpredictability through large home range sizes and a correlation can often be drawn between home range size and overall habitat quality.

Poor quality habitat is cited by many researchers as being a primary cause of decreased production, however the source of habitat degradation for grizzly bears is a complex array of numerous factors. The majority of food item preferred by grizzly bears occur characteristically in early seral communities where forest cover is absent or under-stocked (Hamer and Herrero 1983). While biologists are in general agreement that the preferred habitat of grizzly bears in Alberta are fire-successional, early seral types, Weilgus (1986) has found that male grizzlies in Kananaskis Country utilized old growth spruce and pine forests to hunt ungulate calves and feed on emerging *Equisetum* spp.

Another attribute of grizzly bear ecology that is directly related to large spatial requirements is the need for solitude. Female grizzly bears with cubs often inhabit remote areas away from the presence

of other bears in order to maximize safety of cubs and to facilitate undisturbed dam-cub interactions. Dens are characteristically located at high elevations in remote areas with slopes that are greater than 30 percent, soils that are deep and easily excavated, and aspects where insulative snow can accumulate (Craighead and Craighead 1972, Servheen 1981). Grizzly bears have been shown to exhibit depressed metabolic rates similar to the 35 - 75 percent reductions reported for black bear (Watts and Jonkel 1988). The energetic costs of winter dormancy in grizzly bears is high; behavioral strategies have evolved to compensate for such costs, however, the use of sub-optimal den sites or anthropogenic disturbances during denning may accelerate starvation and could lead to den abandonment during or even after excavation.

General recommendations made by Banci (1991) in the federal COSEWIC grizzly bear status report reflect the large habitat requirements of the species and also reflect the need for effective land-use management. Land use strategies suggested by COSEWIC include:

1. *Long term access management plans that include reducing existing access to regain wilderness across large landscapes are necessary. Jurisdictions need to consider "cattle-free", "oil-free", "or mine-free" zones, and in areas of high human habitation, "grizzly bear-free" zones.*

2. *Long term forest management plans are needed to ensure the existence of adequate foraging sites with adjacent cover for grizzly bears.*

3. *The establishment of reserves ("kill-free" zones or "carnivore conservation areas"), inaccessible areas which are not open to hunting and have minimal (preferably nil) land use activities. It cannot be assumed that parks will fill this need.*

4. *The integration of human activities or cumulative effects into habitat analyses and land use plans.*

Viable grizzly bear populations require large contiguous areas that meet the species' biological requirements. Exceptions can occur where foods are highly concentrated and predictable in space

and time, such as in southeast Alaska. These areas can support much higher population densities and, resultantly, smaller home range sizes because of the amount and predictability of forage resources. In most interior areas such as the Rocky Mountains and foothills of Alberta, grizzly bear densities are low because forage items are not predictable in space and time. Due to this low population density, large areas are necessary to maintain minimum viable populations. The characteristics of space, diversity of food items, and solitude must be provided within large grizzly bear habitats in order for the habitat to be utilized.

Grizzly bears have been historically described as using the Kootenay Plains habitats to hunt elk and moose (numerous references, cited in Mussell 1982). In recent times, however, it is likely that grizzly bears have reverted to higher elevation sub-alpine habitats above the Ecological Reserve itself. In such areas, high-elevation burns and avalanche chutes are excellent berry producers and provide quality summer and fall forage.

Wolverine have been classified as one of North America's rarest mammals and least known large carnivore. Banci (1994) reported wolverine to live at very low densities even under the most optimal conditions. Although wolverine range throughout most of western and northern Canada, including the Rocky Mountains and foothills of Alberta, very little is known about the elusive species. Only four North American field studies on wolverine have been completed; two in Alaska (Gardner 1985, Magoun 1985) and one each in Yukon Territory (Banci 1987) and Montana (Hornocker and Hash 1981). The paucity of information is largely due to the difficulty and expense of studying a solitary, secretive animal that is rare compared to other carnivores and is usually found in remote places. The abundance, and even occurrence, of wolverine in the Kootenay Plains Ecological Reserve is not known, however suitable range (forest cover, isolation, solid and diverse prey base, *et cetera*) is present in the area.

4.5.5 Significant Fauna by Community Type

Wildlife species inhabiting or using the Kootenay Plains Ecological Reserve require numerous life support requisites for reproduction and, ultimately, survival. Thus, species presence (or lack thereof) and relative abundance is determined by habitat features which provide food, cover, and space. ***Food*** (vegetative or animal matter, water, and trace minerals) should provide all the nutritional requirements necessary for growth, development, maintenance, and reproduction. ***Cover*** may be required for thermal, reproductive, escape, resting, and roosting purposes. A number of landscape components, including vegetation, landforms, topography, and aquatic forms, may serve these functions. Thus, wildlife habitat can be defined as *"the physical and biological environment that provides or detracts from the essentials of food, cover, and space that are needed by a population of animals for reproduction, maintenance, and growth"*. The habitat requirements of species in the Ecological Reserve vary seasonally as well as with sex, age, and reproductive status. Table 5 summarizes, by vegetation community type as identified by map unit (Map 1), the distribution and occurrence or potential occurrence of selected significant faunal species within the Kootenay Plains Ecological Reserve. An annotated list of fauna is provided in Appendix 5.

Table 5: Expected Wildlife Use of Vegetation Community Types

COMMUNITY TYPE	FAUNA							
	elk	moose	bighorn sheep	grizzly bear	Cooper's hawk	Vesper sparrow	pileated woodpecker	great gray owl
1				●	●			
2	●●●			●●●		●●		
3		●●●						
4	●●●			●				
5				●●	●●●		●●●	●●●
6			●●				●●	
7		●						
8	●		●●●					
9	●●		●●●			●●		
10	●●		●			●●		
11	●●●		●●●			●●●		●●
12	●●●	●				●●		
13		●●●		●				
14		●●●		●●		●		
15		●●●		●●	●		●	●

●●●	**extensively utilized**	●●	**moderately utilized**	●	**marginally utilized**

4.6 Significant Sites and Areas

The following is a summary of significant sites and areas identified in the Kootenay Plains Ecological Reserve study area. Key features of each site are also listed. A detailed discussion of each site can be found in Section 6.0.

Provincially Significant Sites

Site/Area Name	Key Features
Montane grasslands	- one of only two northern cordilleran representatives of extensive montane grassland in Alberta - high potential for rare plants - key mule deer and bighorn sheep habitat - important elk winter range
Montane woodlands	- one of only two northern cordilleran representatives of extensive montane woodland in Alberta - key mule deer, bighorn sheep and moose habitat - important elk winter range
Limber pine communities	- one of only two such areas north of the Bow River
Unique wetland	- unique vegetative community - plant species include mountain mare's-tail (*Hippuris vulgaris*), Franklin's sedge (*Carex franklinii*), rocky-ground sedge (*Carex saxatilis*) and sedge (*Carex simulata*)
Unique meadow	- vegetative community not described elsewhere in Alberta - plant species include one-flowered ironplant (*Haplopappus unifloris*), western wheatgrass (*Agropyron smithii*) and Nuttall's salt-meadow grass (*Puccinellia nuttalliana*)

Regionally Significant Sites

Site/Area Name	Key Features
Siffleur River	- provides critical hydrological function, including groundwater discharge - provides habitat for a number of rare and uncommon plant species - Siffleur Falls and Siffleur Canyon - key recreational resource
Whiterabbit Creek	- provides critical hydrological function, including groundwater discharge - provides habitat for a number of rare and uncommon plant species - braided stream
Loudon Creek	- provides critical hydrological function, including groundwater discharge
Alkaline pond and seepage area	- regionally unique vegetative communities
Spring-fed wetland	- regionally diverse wetland
Calcareous cliff	- regionally diverse calcareous cliff vegetation
Riverside seepage areas	- provides habitat for regionally uncommon vegetation
Channel edge and meander pools	- provides habitat for fish and uncommon vegetatation
Meadow	- regionally significant meadow vegetation

Locally Significant Sites

Site/Area Name	Key Features
Ponds	- locally significant waterfowl habitat
Wetlands	- provides habitat for locally significant plants
Spring fens	- provides habitat for locally significant plants

5.0 SENSITIVE FEATURES

Environmental sensitivity ratings are often used as an evaluation of the performance of a site in response to various land uses or disturbance types (Bentz and Saxena 1993, O'Leary et al. 1993). On lands which have a low sensitivity to disturbance, many disturbances can be easily remedied by standard operating procedures. Conversely, other lands may be more sensitive to disturbance because they possess at least one of the following characteristics (Bentz and Saxena 1993):

- a very high susceptibility to erosion
- severe limitations to revegetation, or
- distinctive, rare or unusual landforms, wildlife populations or plant communities that are regionally, provincially, nationally or internationally important.

The identification of sensitive features encompasses the overlaying of three mapping themes, specifically, vegetation community types, significant features and slope class. This method is consistent with that developed for previous sensitive areas studies (Bradshaw et al. 1995, 1994). The resulting polygons are then evaluated and classified according to the following classes:

High:	The disturbance can be expected to result in a complete loss of the significant natural feature or require major mitigation and very restrictive operating conditions to maintain the vital ecological functions of the feature.
Moderate:	The disturbance will result in considerable loss or modification of the significant natural feature. Significant mitigation and restrictive operating conditions are likely required to maintain the vital ecological functions of the feature.
Low:	The disturbance will result in minor loss or modification to the significant natural feature. Some mitigation and normal operating restrictions may be required to maintain the long term viability and vitality of the feature.

Insignificant: The disturbance will have no measurable impact on the significant ecological feature.

6.0 CHECKLISTS OF SIGNIFICANT FEATURES

The following are descriptions or checklists of mappable significant features identified in the Kootenay Plains Ecological Reserve. Locations of these sites are presented in Map 2. As well, an overall sensitivity rating is given for each site or feature.

The significant features checklists are grouped by level of significance, from provincial to local significance.

Site Name: **Montane Grasslands**

Site Location: throughout study area

Description:

- large portions of the North Saskatchewan River valley floor and adjacent fans and terraces consist of disjunct montane grassland communities

Significance: **Provincial**

- one of only two northern cordilleran representatives of extensive montane woodland and grassland in Alberta
- the largest, most diverse area of disjunct Montane vegetation in Alberta
- extensive and diverse grassland communities
- habitat for rare Albertan species including one-flowered ironplant (*Haplopappus uniflorus*) and mountain mare's-tail (*Hippuris montana*)
- numerous disjunct grassland or montane plant species
- unique plant species composition lacking rough fescue (*Festuca campestris*) - a dominant component of the contiguous Montane sub-region grasslands and the Clearwater River grasslands to the east
- spring grizzly bear (*Ursus arctos*) habitat on south facing slopes
- important elk (*Cervus elaphus*) winter range
- key mule deer (*Odocoileus hemionus*) and bighorn sheep (*Ovis canadensis*) habitat
- spotted frog (*Rana pretiosa*) habitat (rare species in this region)
- the unit has potential for other rare plant species due to the diverse habitats found within the grassland

Sensitivity: High

Comments:

- grizzly bear and spotted frog populations have been documented in and around the study area. Detailed investigations are recommended to determine whether these populations exist within the study area.
- horse grazing and off-highway vehicle use have had a negative impact on grassland vegetation and wildlife.

References:

- 1995 field investigations
- Alberta Environmental Protection (1995)
- Alberta Government (1994)
- Sweetgrass Consultants Ltd. (1989)
- Mussell (1982)
- Wallis and Wershler (1981)
- Kondla (1974)
- Alberta Lands and Forests (1973)

Site Name: **Montane Woodlands**

Site Location: throughout study area

Description:

- large portions of the North Saskatchewan River valley floor and adjacent fans and terraces consist of disjunct montane woodland communities

Significance: **Provincial**

- one of only two northern cordilleran representatives of extensive montane woodland in Alberta
- the largest, most diverse area of disjunct Montane vegetation in Alberta
- extensive limber pine (*Pinus flexilis*) communities and isolated Douglas fir (*Pseudotsuga menziesii*) communities
- has several sites with heterogeneous habitat comprised of uncommon, interspersed vegetation communities
- habitat for rare Albertan species including glandular Labrador tea (*Ledum glandulosum*), one-lowered ironplant (*Haplopappus uniflorus*), and mountain mare's-tail (*Hippuris montana*)
- numerous disjunct montane plant species such as needle and thread grass (*Stipa comata*)
- spring grizzly bear (*Ursus arctos*) habitat on south facing slopes
- important elk (*Cervus elaphus*) winter range
- key mule deer (*Odocoileus hemionus*), bighorn sheep (*Ovis canadensis*) and moose habitat (*Alces alces*)
- presence of a mineral lick which is utilized by bighorn sheep and other ungulates
- potential habitat for caribou (*Rangifer tarandus*)
- spotted frog (*Rana pretiosa*) habitat (rare species in this region)

- the unit has potential for other rare plant species due to the diverse habitats found within the reserve

Sensitivity: High

Comments:

- caribou and grizzly bear populations have been documented in and around the study area. Detailed investigations are recommended to determine whether these populations exist within the study area.

References:

- 1995 field investigations
- Alberta Environmental Protection (1995)
- Alberta Government (1994)
- Sweetgrass Consultants Ltd. (1989)
- Mussell (1982)
- Wallis and Wershler (1981)
- Kondla (1974)
- Alberta Lands and Forests (1973)

Site Name: **Limber Pine Communities**

Site Location: throughout study area, primarily on glaciofluvial and isolated colluvial deposits

Significance: **Provincial**

- limber pine (*Pinus flexilis*) is restricted to montane environments and these sites represent the largest limber pine communities found in this region
- limber pine stands include trees up to 1000 years old, one of which has been designated "a tree of renown" due to its ecological and heritage value
- bighorn sheep (*Ovis canadensis*) habitat in the study area is largely limited to these open, wind-swept slopes occupied by limber pine

Sensitivity: High

References:

- 1995 field investigations
- Alberta Environmental Protection (1995)
- Alberta Government (1994)
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name: **Unique Wetland**

Site Location: southern portion of the study area, located in NE 14- Twp.36 - Rge.18 - W5M

Description:

- the unit consists of a small wetland occurring between Highway No. 11 and the North Saskatchewan River, in the southern half of the study area
- the wetland is found in a poorly drained depressional area and consists of glaciofluvial materials

Significance: **Provincial**

- this wetland provides habitat for a provincially significant vegetative community
- plant species include mountain mare's-tail (*Hippuris montana*), One-flowered ironplant (*Happlopappus uniflorus),* bluegrass (*Poa stenantha*), Franklin's sedge, (*Carex franklinii*), rocky-ground sedge (*Carex saxatilis*) and sedge (*Carex simulata*)
- potential habitat for spotted frog (*Rana pretiosa*) and western toad (*Bufo boreas*); also likely temporary use by waterfowl

Sensitivity: High

References:

- Alberta Environmental Protection (1995)
- Alberta Government (1994)
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name: **Unique Meadow**

Site Location: southern portion of the study area, located in SW 24 - Twp.36 - Rge.18 - W5M

Description:

- the site is located west of Highway No. 11 and consists of glaciofluvial materials with an discontinuous eolian veneer

Significance: **Provincial**

- this site provides habitat for a vegetative community not described elsewhere in Alberta
- plant species include one-flowered ironplant (*Haplopappus unifloris*), western wheatgrass (*Agropyron smithii*) and Nuttall's salt-meadow grass (*Puccinellia nuttalliana*)

Sensitivity: High

References:

- Alberta Government (1994)
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name: **Siffleur River**

Site Location: central and southern portions of the study area

Description:

- lower portion including Siffleur Falls and confluence with North Saskatchewan River
- key wildlife movement corridor
- high landform diversity (meanders, point bars,canyons,waterfall)

Significance: **Regional**

- a regionally important watercourse
- contains Siffleur Falls and Siffleur Canyon, outstanding heritage features with bedrock exposures containing fossils
- braided river sections support the rare plant dwarf Canadian primrose (*Primula mistassinica*)
- provides critical hydrological function, including groundwater discharge
- provides habitat for a number of rare and uncommon plant species
- sustains a portion of the study area's population of 11 fish species including mountain whitefish (*Prosopium williamsoni*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), cutthroat trout (*Salmo clarki*), rainbow trout (*Salmo gairdneri*), longnose dace (*Rhinichthys cataractae*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus catostomus*), white sucker (*Catostomus commersoni*), mountain sucker (*Catostomus platyrhynchus*) and spoonhead sculpin (*Cottus ricei*)
- has not been verified, but Harlequin duck (*Histrionica histrionica*) habitat is potentially very good in upper reaches

Sensitivity: Moderate

References:

- 1995 field investigations
- Alberta Environmental Protection (1995)
- Alberta Government (1994)
- O'Leary et. al. (1993)
- Sweetgrass Consultants Ltd. (1989)
- Mussell (1982)
- Wallis and Wershler (1981)
- Kondla (1974)
- Tebby (1974a)
- Tebby (1974b)

Site Name: **Whiterabbit Creek**

Site Location: central portion of the study area

Description:

- lower portion and mouth of Whiterabbit Creek
- important wildlife movement corridor
- high landform diversity (meanders, islands, point bars)

Significance: **Regional**

- a regionally important watercourse
- provides critical hydrological function, including groundwater discharge
- provides habitat for a number of rare and uncommon plant species
- sustains a portion of the study area's population of 11 fish species including mountain whitefish (*Prosopium williamsoni*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), cutthroat trout (*Salmo clarki*), rainbow trout (*Salmo gairdneri*), longnose dace (*Rhinichthys cataractae*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus catostomus*), white sucker (*Catostomus commersoni*), mountain sucker (*Catostomus platyrhynchus*) and spoonhead sculpin (*Cottus ricei*)
- excellent movement corridor for ungulates and large mammals

Sensitivity: Moderate

References:

- 1995 field investigations
- Alberta Government (1994)
- O'Leary et. al. (1993)
- Sweetgrass Consultants Ltd. (1989)
- Mussell (1982)
- Wallis and Wershler (1981)
- Kondla (1974)
- Tebby (1974a)
- Tebby (1974b)

Site Name: **Loudon Creek**

Site Location: southeastern corner of the study area

Description:

- lower portion and mouth of Loudon Creek
- important wildlife movement corridor
- high landform diversity (meanders, islands, point bars)

Significance: **Regional**

- a regionally important watercourse
- provides critical hydrological function, including groundwater discharge
- provides habitat for a number of rare and uncommon plant species
- sustains portions of a population of 11 fish species including mountain whitefish (*Prosopium williamsoni*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), cutthroat trout (*Salmo clarki*), rainbow trout (*Salmo gairdneri*), longnose dace (*Rhinichthys cataractae*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus catostomus*), white sucker (*Catostomus commersoni*), mountain sucker (*Catostomus platyrhynchus*) and spoonhead sculpin (*Cottus ricei*)

Sensitivity: Moderate

References:

- 1995 field investigations
- Alberta Government (1994)

- O'Leary et. al. (1993)
- Sweetgrass Consultants Ltd. (1989)
- Mussell (1982)
- Wallis and Wershler (1981)
- Kondla (1974)
- Tebby (1974a)
- Tebby (1974b)

Site Name: **Alkaline Pond and Seepage Area**

Site Location: southern portion of the study area, located in parts of NW 19 & SW19 - Twp.36 - Rge.17 - W5M

Description:

- this site includes an alkaline pond and calcareous seepage area, with tufa, consisting of fluvial materials
- it is located within old meander scars of the North Saskatchewan River and consists of a highly erodible silt-sand substrate

Significance: **Regional**

- regionally significant vegetative communities occupy this habitat
- rare and uncommon plant species include short-awned sedge (*Carex microglochin*), sea milkwort (*Glaux maritima*), alpine bearberry (*Arctostaphylos rubra*), one-flowered ironplant (*Happlopappus uniflorus*), and northern lady's-slipper (*Cypripedium passerinum*)
- provides seasonally variable habitat for moose (*Alces alces*)
- wetlands provide habitat for shorebirds, insects and emergent and aquatic plant communities

Sensitivity: High

Comments:

- this community is subject to the flooding of the North Saskatchewan River.

References:

- Alberta Environmental Protection (1995)
- Alberta Government (1994)
- Sweetgrass Consultants Ltd. (1989)
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name: **Spring-fed Wetland**

Site Location: found in parts of NE 25 - Twp.36 - Rge.18 - W5M and SE 36 - Twp.36 - Rge.18 - W5M

Description:

- springs occurring between two adjacent cliffs produce a diverse wetland with minor tufa deposits.

Significance: **Regional**

- this wetland supports regionally significant vegetation such as alpine bearberry (*Arctostaphylos rubra*), glandular Labrador tea (*Ledum glandulosum*), common butterwort (*Pinguicula vulgaris*), western lousewort (*Pedicularis bracteosa*) and northern twayblade (*Listera borealis*)
- good moose (*Alces alces*) habitat

Sensitivity: Moderate

References:

- Alberta Government (1994)
- Sweetgrass Consultants Ltd. (1989)
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name: **Calcareous Cliff**

Site Location: found in parts of NE 25 - Twp.36 - Rge.18 - W5M and SE 36 - Twp.36 - Rge.18-W5M

Description:

- the site is immediately adjacent to the spring fed meadow mentioned above
- it includes a steeply inclined slope consisting of colluvial materials

Significance: **Regional**

- this slope provides a calcareous cliff habitat for regionally significant plant species
- some of these plant species include prairie selaginella (*Selaginella densa*), slender lip fern (*Cheilanthes feei*) and smooth cliff brake (*Pellaea glabella*)
- bighorn sheep (*Ovis canadensis*) use of lower-elevation habitats in the study area is dependent upon adjacency of these types of rough escape terrain

Sensitivity: High

Comments:

- cliffs similar to this one are found sporadically throughout the Kootenay Plains Ecological Reserve. This particular cliff, however, provides the most diverse and extensive vegetative cliff community found in this region.

References:

- Alberta Government (1994)
- Sweetgrass Consultants Ltd. (1989)
- Wallis and Wershler (1981)

Site Name: **Riverside Seepage Areas**

Site Location: found in parts of SW 29-Twp.36-Rge.17-W5M; NW 29-Twp.36 - Rge.17- W5M and SW 30 - Twp.36 - Rge.17- W5M

Description:

- these sites are wetlands that exist either on or close to the North Saskatchewan River bank, occurring in water discharge areas and consisting of glaciofluvial and fluvial materials

Significance: **Regional**

- these seepage related wetlands provide habitat for regionally significant vegetative communities
- significant plant species include dwarf false asphodel (*Tofieldia pusilla*), small northern grass-of-parnassus (*Parnassia parviflora*), one-spike cotton grass (*Eriophorum scheuchzeri*), simple bog-sedge (*Kobresia simpliciuscula*), tufted bulrush (*Scirpus cespitosus*), northern lady's-slipper (*Cypripedium passerinum*), one-flowered iron plant (*Happlopappus uniflorus*), and yellow rattle (*Rhinanthus minor*)

Sensitivity: Moderate

References:

- 1995 field investigations
- Alberta Government (1994)
- Sweetgrass Consultants Ltd. (1989)
- Wallis and Wershler (1981)

Site Name: **Meadow**

Site Location: southern portion of the study area, located in NW 30-Twp.36 - Rge.17 - W5M

Description:

- the site is located adjacent to Highway No.11 and consists of glaciofluvial materials with eolian veneers
- it includes a montane grassland community with numerous shallow depressional areas

Significance: **Regional**

- the depressional areas provide habitat to regionally significant plant communities
- significant plants include one-flowered ironplant (*Haplopappus uniflorus*), grape fern (*Botrychium dusenii*), western wheatgrass (*Agropyron smithii*) and Richardson's sedge (*Carex richardsonii*)
- grazing potential is high for elk (*Cervus elaphus*) and, sometimes, sheep (*Ovis canadensis*)

Sensitivity: High

References:

- 1995 field investigations
- Alberta Government (1994)
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name:	**Channel Edge and Meander Pools**
Site Location:	found in numerous locations along The North Saskatchewan River in the central portion of the study area

Description:

- banks of temporary side channels along the North Saskatchewan River
- permanent pools within periodically flowing meander channels of the North Saskatchewan River

Significance: **Regional**

- the sites contain significant plant communities and habitats
- periodically sustains a portion of the study area's population of 11 fish species including whitefish (*Prosopium williamsoni*), bull trout (*Salvelinus confluentus*), brook trout (*Salvelinus fontinalis*), cuttroat trout (*Salmo clarki*), rainbow trout (*Salmo gairdneri*), longnose dace (*Rhinichthys catatactae*), longnose sucker (*Catostomus catostomus*), white sucker (*Catostomus commersoni*), mountain sucker (*Catostomus platyrhychus*) and spoonhead sculpin (*Cottus ricei*).
- provides spring spawning areas for the salmonid fish species (whitefish and trout)
- meander pools support "course" fish species such as longnose dace and mountain sucker

Sensitivity: Moderate

References:

- 1995 field investigations
- Alberta Environmental Protection (1995)

Site Name: **Ponds**

Site Location: found in parts of SE 14 - Twp.36 - Rge.18 - W5M; SE 20 Rge.17-W5M and SW 21 -Twp.36 Rge.17 - W5M

Description:

- one kettle hole pond found on glaciofluvial materials
- one shallow pond found on glaciofluvial material within rolling ground moraine

Significance: **Local**

- these sites support the only significant pond communities found within the Kootenay Plains Ecological Reserve
- pond perimeters provide habitat for wetland plants, shorebirds, amphibians, and aquatic insects
- provides the only waterfowl habitat that is used to any extent in the study area

Sensitivity: High

References:

- Alberta Environmental Protection (1995)
- 1995 field investigations
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name: **Spring Fens**

Site Location: W 1/2 - 24 - Twp.36 - Rge. 18 - W5M

Description:

- the unit contains two spring-fed fens in the southern half of the study area
- these fens have generally shallow organic deposits (less than 20 centimeters) overlying glaciofluvial materials

Significance: **Local**

- provide habitat for locally significant plant populations
- significant plant species include common butterwort (*Pinquicula vulgaris*), small northern grass-of-parnassus (*Parnassia parviflora*), one-flowered ironplant (*Happlopappus uniflorus*), and sedge (*Carex simulata*)

Sensitivity: High

References:

- Alberta Government (1994)
- Wallis and Wershler (1981)
- Kondla (1974)

Site Name: **Wetlands**

Site Location: found in the S.E. portion of the study area

Description:

- several organic wetlands found in shallow glaciofluvial channels in rolling ground moraine

Significance: **Local**

- bogs supports locally significant plant species including sphagnum (*Sphagnum* spp.) and dwarf nagoonberry (*Rubus arcticus*).
- type restricted to morainal uplands in Kootenay Plains Ecological Reserve
- interspersed plant communities provide good edge habitat for several bird species
- wetland edges provide habitat for moose (*Alces alces*)

Sensitivity: High

References:

Alberta Environmental Protection (1995)
Kondla (1974)

7.0 DATA GAPS

The identification of significant features, particularly of rare flora and fauna, relied heavily on review of existing information as field time allocated for the project was insufficient to conduct the intensive surveys required to identify populations in the field. Extrapolation was often required of data from studies in areas adjacent to the Kootenay Plains Ecological Reserve. This study will therefore be best used as an initial source to "flag" potential areas of concern related to any proposed developmental activity. Detailed field study will be required to confirm site-specific occurrences of significant flora and fauna within the study area.

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APPENDIX 1: FROST DESIGN CLASSIFICATION

Adapted from United States Army Corps of Engineers (1962)

Frost Group	Kind of Soil	% by weight, finer than 0.02 mm	Typical Soil Types (USCS)	Typical Soil Textures (CSSC)
F1	Gravelly soils	3-10	GW,GP,GW-GM,GP-GM	g
F2	Gravelly soils	10-20	GM,GW-GM,GP-GM	g,gL
	sands	3-15	SW,SP,SM,SW-SM,SP-SM	S,fS,cS
F3	Gravelly soils	over 20	GM,GC	gL,gC
	Sands except very fine silty sands	over 15	SM,SC	LS
	Clays, P.I. >12	-	CL,CH	C,SiC,L
F4	All silts	-	ML,MH	Si,SiL,SiC
	Very fine silty sands	over 15	SM	fSI,vfS
	Clays P.I.>12	-	CL,CL-ML	SC, SiCL
	Varved clays and otehr fine grained, banded sediments	-	CL & ML; CL,ML &SM; CL,CH &ML; CL,CH,ML & SM	L & CL;CL,L &SL;CL,C &L; CL,C,L & SL

APPENDIX 2: ROCKINESS CLASSES

Rockiness is recorded as classes based on the percentage of surface occupied by exposed bedrock.

ROCKINESS	SURFACE OCCUPIED BY BEDROCK (%)
Non-rocky	<2
Slightly rocky	2-10
Moderately rocky	10-25
Very rocky	25-50
Exceedingly rocky	50-90

Definitions:

Rocky 0. Non-rocky land - bedrock exposure covers less than 2 percent of the surface and is more than 100 m apart. There is minor interference with tillage.

Rocky 1. Slightly rocky land - sufficient bedrock exposures to interfere with tillage but not to make intertilled crops impracticable. Depending on how the pattern affects tillage, rock exposures are roughly 35 - 100 m apart and cover 2 - 10 % of the surface, depending on the pattern.

Rocky 2. Moderately rocky land - sufficient bedrock exposures to make tillage of intertilled crops impractical, but soil can be worked for hay crops or improved pasture if other soil characteristics are favourable. Rock exposures are roughly 10 - 35 m apart and cover 10 - 25 % of the surface, depending on the pattern.

Rocky 3. Very rocky land - sufficient rock outcrop to make use of machinery impractical, except for light machinery where other soil characteristics are especially favourable for improved pasture. The land may have some use for wild pasture or forests, depending on other soil characteristics. Rock exposures or patches of soil covering too thinly over rock for use, are roughly 3.5-10 m apart and cover 25-50 % of the surface, depending on the patterns.

Rocky 4. Exceedingly rocky land - sufficient rock outcrops (or very thin soil over rock) to make all use of machinery impractical. The land may have some value for poor pasture or forests. Rock outcrops are 3.5 m or less apart and cover 50 - 90 % of the area.

APPENDIX 3: SURFACE STONINESS CLASSES [1]

Adapted from Canada Soil Survey Committee (1987)

Stoniness Class	Description
Stony 0	non-stony phase - very few stones (<0.01 % of surface, stones >30 m apart)
Stony 1	slightly stony phase - some stones that hinder cultivation slightly or not at all (0.01 - 3 % of surface, stones 10 - 30 m apart)
Stony 2	moderately stony phase - enough stones to cause some interference with cultivation (0.1 - 3 % of surface, stones 2 - 10 m apart)
Stony 3	very stony phase - sufficient stones to handicap cultivation seriously; some clearing is required (3-15 % of surface, stones 1-2 m apart)
Stony 4	exceedingly stony phase - sufficient stones to prevent cultivation until considerable clearing is done (15-50 % of surface, stones 0.1 - 0.5 m apart)
Stony 5	excessively stony phase - too stony to permit cultivation; boulder or stone pavement (> 50 % of surface, stones <0.1 m apart)

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[1] Phases of stoniness are defined on the basis of the percentage of the land surface occupied by fragments coarser than 15 cm in diameter.

APPENDIX 4: RARE, UNCOMMON AND DISJUNCT PLANT SPECIES OF THE KOOTENAY PLAINS

Adapted from Wallis and Wershler (1981) and Alberta Government (1994)

SPECIES	Common Name	Habitat	Alberta Status[1]	Kootenay Plains Status[2]
Botrychium dusenii	Grape fern	Grasslands and lowland meadows	Rare	Rare
Braya humilis	Leafy braya	Gravel and sandy flats	Rare	Rare
Carex franklinii	Franklin's sedge	Coniferous forests and grasslands	Rare	Rare
Carex microglochin	Short-awned sedge	Creeks and calcareous peatland	Rare	Rare
Draba fladnizensis	Whitlow-grass	Rock; eroded slopes; outcrops; ridges; cliffs and canyon walls	Rare	Rare
Eriophorum scheuchzeri	One-spike cotton grass	North Saskatchewan and Siffleur Rivers	Rare	Rare
Happlopappus uniflorus	One-flowered ironplant	Grassland, coniferous forests, river and shrub peatland	Rare	Locally Common
Hippuris montana	Mountain mares-tail	Lowland wetlands	Rare	Locally Common
Kobresia simpliciuscula	Simple bog-sedge	North Saskatchewan and Siffleur Rivers and isolated seepage areas	Rare	Locally Common
Ledum glandulosum	Glandular Labrador Tea	Calcareous peatland with rock and creek peatland	Rare	Rare
Parnassia parviflora	Small northern grass-of-parnassus	River and shrub peatland	Rare	Locally Common
Pellaea glabella	Smooth cliff brake	Calcareous rock; eroded slopes; outcrops; ridges; cliffs; canyon walls and coniferous forests with rock	Rare	Rare
Poa stenantha	Bluegrass	Lowland wetlands and seepage areas	Rare	Rare
Primula mistassinica	Dwarf Canadian primrose	Creeks, rivers and Coniferous forests	Rare	Locally Common
Salix alaxensis	Alaska willow	River and shrub peatland	Rare	Rare
Botrychium lunariar	Moonwort	Grasslands	Uncommon	Rare

Cheilanthes feei	Slender lip fern	Calcareous rock; eroded slopes; outcrops; ridges; cliffs; canyon walls and coniferous forests with rock	Uncommon	Uncommon
Cypripedium passerinum	Northern lady's-slipper	Creeks, rivers and forested areas	Uncommon	Locally Common
Carex raymondii	Raymond's sedge	Peatland and lowland meadows	Locally Common	Rare
Listera borealis	Northern twayblade	Creeks and calcareous peatland	Locally Common	Rare
Scirpus cespitosus	Tufted bulrush	North Saskatchewan and Siffleur Rivers	Locally Common	Rare
Silene drummondii	Drummond's cockle	Grassland	Locally Common	Rare
Tofieldia pusilla	Dwarf false asphodel	Rivers, creeks and calcareous peatland	Locally Common	Rare
Rhinanthus minor	Yellow rattle	Rivers and creeks	Locally Common	Locally Common
Agropyron smithii	Western wheatgrass	Grasslands, lowland meadows and riversides	Disjunct	Locally Common
Asragalus miser	Timber milk vetch	Forested areas	Disjunct	Rare
Festuca idahoensis	Bluebunch fescue	Grasslands	Disjunct	Rare
Glaux maritima	Sea milkwort	Rivers, creeks and calcareous peatland	Disjunct	Rare
Helictotrichon hookeri	Hooker's oat grass	Grasslands and tree and shrub-grassland transition zones	Disjunct	Scarce
Lactuca pulchella	Common blue lettuce	Tree and shrub-grassland transition zones	Disjunct	Scarce
Lithospermum incisum	Narrow-leaved puccoon	Riversides	Disjunct	Rare
Orobanche fasciculata	Clustered broom-rape	Grasslands	Disjunct	Rare
Pinus flexilis	Limber pine	Calcareous rock; eroded slopes; outcrops; ridges; cliffs; canyon walls; and coniferous forest- grassland transition zones	Disjunct	Locally Common
Plantago eriopoda	Saline plantain	Creeks, rivers, calcareous peatland and moist coniferous forests	Disjunct	Locally Common

Pseudotsuga menziesii	Douglas-fir	Coniferous forest and shrub-grassland transitional zones; rock; eroded slopes; outcrops; ridges; and cliffs	Disjunct	Uncommon
Puccinellia nuttalliana	Nuttall's salt-meadow grass	Lowland meadows and calcareous grasslands	Disjunct	Rare
Selaginella densa	Prairie selaginella	Calcareous rock; eroded slopes; outcrops; cliffs; canyon walls	Disjunct	Rare
Stipa comata	Needle-and-thread	Grasslands	Disjunct	Locally Common
Townsendia hookeri	Hooker's townsendia	Grasslands and creek banks	Disjunct	Rare
Townsendia parryi	Parry's townsendia	Lowland meadows and shrub-grassland transition zones	Disjunct	Locally Common

[1] Alberta Status, Source: Wallis, C., C. Bradley, M. Fairbarns and V. Loewen. 1987. The rare flora of Alberta: Volume 3, species summary sheets. Alberta Forestry, Lands and Wildlife. and,
Wallis, C. And C. Wershler. 1981. Kootenay Plains: flora and grassland vegetation. Cottonwood Consultants Ltd.

[2] Kootenay Plains Status Source: Wallis, C. And C. Wershler. 1981. Kootenay Plains: flora and grassland vegetation. Cottonwood Consultants Ltd.

APPENDIX 5

Fish and Wildlife Species With Potential Habitats in the Kootenay Plains Ecological Reserve

SPECIES		STATUS[1]	HABITAT AND DISTRIBUTION
MAMMALS			
masked shrew	*Sorex cinerius*	-	Very common throughout Alberta except extreme SE. Occupies all types of habitats in study area, including damp meadows, deadfall in coniferous forest, mixedwood forests.
dusky shrew	*Sorex monticolus*	-	Widely distributed in Alberta, most common in alpine meadows.
water shrew	*Sorex palustris*	-	Found throughout northern Alberta and the Rocky Mountains. Uncommon throughout its range, where it is found along water edges of creeks, ponds, and lakes.
pygmy shrew	*Sorex hoyi*	-	Dry, upland coniferous forests throughout northern and western Alberta.
little brown bat	*Myotis lucifugus*	-	Very common throughout the province, suitable habitat includes deciduous and coniferous forests and caves.
long-eared bat	*Myotis evotis*	-	A bat of the mountains and grasslands, considered rare in the mountains where it occupies rock outcrops of river valleys. Reaches northern limit of its range near the Kootenay Plains area.
long-legged bat	*Myotis volans*	-	Sporadically common bat of the western mountains and east to the Milk River. Occupies rocky outcrops and caves. Documented from immediately north of Abraham Lake.
silver-haired bat	*Lasionycteris noctivagans*	Y	Fairly common bat of woodlands in southern three-quarters of Alberta. Roosts in woodpecker holes and loose bark in mixedwood forests.
big brown bat	*Eptesicus fuscus*	-	Relatively common in Alberta, except NW corner. Largely dependent on man-made nest sites, so is likely rare in the Kootenay Plains area.
hoary bat	*Lasiurus cinereus*	-	Relatively common bat throughout Alberta, except extreme NW. Deciduous and coniferous forests provide suitable habitat everywhere.
snowshoe hare	*Lepus americanus*	-	Common species found throughout northern forests and parklands.
least chipmunk	*Tamias minimus*	-	Most widely distributed chipmunk in Alberta. Most common in alpine and foothill areas, where it inhabits meadows and shrubby forest edges. Has been documented to be common in the Kootenay Plains as well.
yellow-pine chipmunk	*Tamias amoenus*	Y	Restricted to alpine habitats and has been reported as conspicuously absent from a stretch of montane habitat in southern Jasper and northern Banff national parks.
Columbian ground squirrel	*Spermophillus columbianus*	Y	Found throughout the mountains and foothills in alpine meadows, valley bottoms, and rocky slopes. Documented from the North Saskatchewan River valley near the Kootenay Plains.

golden-mantled ground squirrel	*Spermophillus lateralis*	-	Found throughout coniferous and mixedwood forests in mountains and foothills. Generally common throughout its range, occupying rocky outcrops, dense shrubs, and open forests.
red squirrel	*Tamias hudsonicus*	-	Common throughout most of Alberta, except grasslands. Documented from coniferous and mixedwood forests in the Kootenay Plains Ecological Reserve.
northern flying squirrel	*Glaucomys sabrinus*	-	Rare throughout its range in northern and western Alberta. Locally common in areas where suitable habitat exists, such as coniferous and mixedwood forests with woodpecker nesting holes.
beaver	*Castor canadensis*	-	Can be considered common throughout the province, where there is suitable water.
deer mouse	*Peromyscus maniculatus*	-	Likely the most abundant mammal in Alberta, found throughout the province in a variety of hbitats. Displays remarkable plasticity and adaptability in habitat requirements.
bushy-tailed woodrat	*Neotona cinerea*	-	Widely distributed throughout mountain habitats in Alberta. Caves, crevices, rock slides, and rocky outcrops provide suitable habitat.
southern red-backed vole	*Clethrionomys gapperi*	-	Found throughout most of forested regions in Alberta, where it is one of the most common mammals. Inhabits a variety of forested habitats from dry uplands to moist meadows.
heather vole	*Phenacomys intermedius*	-	Common inhabitat of northern forest and mountain areas, where it is much more abundant in the mountains than in boreal forests. Inhabits damp meadows and shrubby lake margins.
meadow vole	*Microtus pennsylvanicus*	-	Common throughout Alberta in open, grassy, and moist meadows.
long-tailed vole	*Microtus longicaudus*	Y	Restricted largely to mountain habitats, where it is relatively common in damp meadows.
muskrat	*Ondatra zibethicus*	-	Common throughout Alberta, where there is standing or permanent water.
northern bog lemming	*Synaptomis borealis*	-	Widely distributed in Alberta but is uncommon, even in appropriate habitats such as moist meadows and bogs in northern forest and subalpine areas.
western jumping mouse	*Zapus princeps*	-	Common in southern half of Alberta. Found along streams and moist meadows, this species has been reported frequently from the Kootenay Plains area.
porcupine	*Erethizon dorsatum*	-	Common throughout the province. More abundant in mixedwoods in the north and wooded riparian areas in the south. Both habitats available in the Kootenay Plains Ecological Reserve.
coyote	*Canis latrans*	-	Common carnivore throuthout Alberta. Broad habitat tolerances allow inhabitation of open grasslands, parklands, and dense boreal forest.
timber wolf	*Canis lupus*	Y	Widely distributed throughout northern Alberta and the Rocky Mountains. Little specific habitat preference, except the need for ungulate prey base. Packs have been documented in the Kootenay Plains Ecological Reserve.
red fox	*Vulpes vulpes*	-	Adaptable, therefore relatively common in all habitats throughout Alberta.
black bear	*Ursus americanus*	-	Common in northern forests and in the Rocky Mountains and foothills.
grizzly bear	*Ursus arctos*	B, C-V	Inhabitant of Rocky Mountain and foothills of Alberta. Uncommon due to large territorial requirements but they frequent river valleys and shrubby slopes in the Kootenay Plains Ecological Reserve and alpine meadows above the Ecological Reserve.

pine marten	*Martes americana*	-	Common in forested regions of northern Alberta and throughout the Rocky Mountains and foothills. Inhabits mature coniferous forests in the study area.
fisher	*Martes pennanti*	Y	An uncommon inhabitant of dense coniferous forests. At extreme southern limit of range near the Kootenay Plains.
ermine	*Mustela erminea*	-	Fairly common in coniferous and mixedwood forests throughout northern forests and parklands, including the Rocky Mountains.
least weasel	*Mustela nivalis*	-	Found throughout the province. It is more common in the aspen parkland region and is considered rare in the Rocky Mountains.
long-tailed weasel	*Mustela frenata*	Y	Occurs throughout the lower two-thirds of Alberta. Considered uncommon in the Rocky Mountains but has been reported from the N. Saskatchewan drainage close to the Kootenay Plains.
mink	*Mustela vison*	-	Common around the margins of lakes, creeks, rivers, and marshes throughout Alberta.
wolverine	*Gulo gulo*	B, C-V	Largest member of the weasel family and one of North America's rarest carnivores. Generally occupies dense forests within its range, which includes northern Alberta forests and the Rocky Mountains south into Montana.
striped skunk	*Mephitis mephitis*	-	Common in a variety of habitats throughout the province.
cougar	*Felis concolor*	B	Principal range is the Rocky Mountains and foothills of western Alberta where this uncommon felid occupies mixedwood forests.
lynx	*Lynx canadensis*	B	Residents of the forested regions of northern Alberta, the foothills, and the Rocky Mountains. Relatively common in areas where they exist in coniferous and mixedwood forests.
elk	*Cervus elaphus*	Y	Found throughout the Rocky Mountains and adjacent foothills, where it is common. Kootenay Plains (grasslands) provide excellent winter range, but numbers utilizing these habitats are subject to fluctuations.
mule deer	*Odocoileus hemionus*	-	Occurs throughout most of the southern two-thirds of the province, where it is common. Occupies mixedwood forests in the mountain portion of its range.
white-tailed deer	*Odocoileus virginianus*	-	Overall range is sympatric with mule deer, however it is much more uncommon in the mountain and foothill habitats.
moose	*Alces alces*	-	Found throughout the forested regions of the province, including the Rocky Mountains and foothills. Inhabits mixedwood forests usually around lake and stream margins.
woodland caribou	*Rangifer tarandus*	R, C-V	Disjunct distribution in Alberta, with the Rocky Mountain and foothills populations reaching their southern range limits in the Siffleur Wilderness Area. They may travel through the Kootenay Plains area during altitudinal migrations.
bighorn sheep	*Ovis canadensis*	Y	Found throughout the Rocky Mountains and foothills of Alberta. Excellent sheep range is found in the Kootenay Plains Ecological Reserve, where they utilize grasslands and steep, terraced slopes.

BIRDS

green-winged teal	*Anas crecca*	Y	Use wooded ponds and streams in boreal and parkland areas. Generally uncommon in Rocky Mountains, however has been documented at Abraham Lake, which is likely a staging site.
blue-winged teal	*Anas discors*	Y	Prefers marshy and slough habitats found further south into the Parkland and Grassland Regions, but also has been documented at Abraham Lake, which is likely a staging site.
mallard	*Anas platyrhychos*	Y	The most abundant duck in the northern hemisphere. It breeds throughout the province, including Abraham Lake.

American wigeon	*Anus americana*	Y	Thought to occur in Rocky Mountain region only as a migrant, however probable nesting has been documented at Abraham Lake.
ring-necked duck	*Aythya collaris*	-	Generally breeds in northern part of province. They prefer fresh, acidic waters rahter than ther alkaline water of the grasslands. Confirmed breeder in the Rocky Mountain national parks and likely also uses Abraham Lake.
lesser scaup	*Aythya affinis*	Y	One of the most abundant ducks in North America. Reported breeding in the Rocky Mountain region, however this has not been confirmed for Abraham Lake, which has been cited as a probable breeding site.
Barrow's goldeneye	*Bucephala islandica*	-	Range limited largely to the Rocky Mountains and foothills of Alberta. A cavity nester, it has been documented nesting at Abraham lake.
common goldeneye	*Bucephala clangula*	-	Widely distributed throughout Alberta and is a common breeder in the central part of the province. Nests in natural tree cavities on lake margins.
bufflehead	*Bucephalus albeola*	-	One of the scarcest ducks in North America. Also a cavity nester but does not favor large, high-elevation lakes.
common merganser	*Mergus merganser*	-	Most of its range in Alberta is in the Rocky Mountains and foothills. A ground nester in wooded shores of lakes and rivers. Has been documented around Abraham Lake but breeding status has not been confirmed.
osprey	*Pandion haliaetus*	B	Found throughout Alberta, except in arid SE portion of province. Invariably found in the vicinity of permanent lakes and rivers and nest sites are located on Abraham Lake and along the N. Sask. R. Near the Kootenay Plains Ecological Reserve.
bald eagle	*Haliaeetus leucocephalus*	B	Generally confined to the northern half of the province. Nests in tall trees near large bodies of water, such as Abraham Lake and the N. Sask. R. Nesting is documented from both of these locations.
red-tailed hawk	*Buteo jamaicensis*	-	One of the most widely distributed and abundant raptors in Canada, they breed throughout Alberta and generally nest in tall trees near forest edges. Likely nests near the Kootenay Plains Ecological Reserve but has not been confirmed as a breeder in the area.
American kestrel	*Falco sparverius*	-	The most common and widely distributed falcon in Alberta usually nests in natural cavities. It has been documented from the area of the Kootenay Plains Ecological Reserve.
Cooper's hawk	*Accipiter cooperii*	B, C-V	Recent declines in population have resulted in a COSEWIC designation for this species as "vulnerable". Prefers closed, dense forests and has been observed near Abraham Lake in the Kootenay Plains Ecological Reserve.
spruce grouse	*Dendragopus canadensis*	-	Resident throughout the year, they are most common in the Rocky Mountains and foothills. Closed pine and spruce forests in Kootenay Plains Ecological Reserve provide habitat. They have been recorded as breeding in this area.
blue grouse	*Dendragopus obscurus*	-	Permanent resident of the Rocky Mountains, which represent the species' only range in Alberta. Inhabits dry slopes and burns in the montane and subalpine regions of drier, lightly wooded valleys of the Front Ranges. Occurs in abundance around Kootenay Plains Ecological Reserve.
ruffed grouse	*Bonasa umbellus*	-	Alberta's most common and widespread grouse. It is very common in the Foothills region. Aspen-dominated mixedwoods are where this species has been documented from the Kootenay Plains Ecological Reserve.
killdeer	*Charadrius vociferus*	-	Common summer resident throughout Alberta. Breeds in open areas such as grassy uplands and woodland clearings. In these habitats, it has been documented from the Kootenay Plains Ecological Reserve.

greater yellowlegs	*Tringa melanoleuca*	-	Widespread throughout the northern half of the province and is most abundant in the Foothills region. Alluvial wetlands and wet shrub meadows are the preferred habitat in the mountain portions of its range. Occurrence in Kootenay Plains area has not been documented but is likely.
solitary sandpiper	*Tringa solitaria*	-	Status unknown but is relatively common throughout Alberta, with concentrations in the Foothills region. Breeds throughout the province, nesting in open, wet woodlands near water.
spotted sandpiper	*Actitis macularia*	-	One of the most widely distributed and well-known shorebirds in Canada. Breeds by freshwater such as Abraham Lake or shores of N. Sask. R. In the Kootenay Plains Ecological Reserve.
common snipe	*Gallingo gallingo*	Y	As common as spotted sandpiper, this species has a holarctic distribution, breeding throughout its range in Alberta. Most commonly found in forested areas of central Alberta, into foothill areas. Likely breeder in Abraham Lake region.
ring-billed gull	*Larus delawarensis*	-	Most abundant gull in North America. Generally occurs in south and east portions of the province; its occurrence in the foothills and mountains is extra-limital. However, it has been observed in the Ecological Reserve.
herring gull	*Larus argentatus*	Y	Breeding habitat limited to northeast portion of the province. However the species is yellow-listed and extralimital sightings have been made in the vicinity of the Kootenay Plains Ecological Reserve.
great horned owl	*Bubo virginianus*	-	The official provincial bird is common throughout most of the province, including the foothills and Rocky Mountains, as it exhibits a broad range of habitat tolerances. It is resident throughout its breeding range and nesting has been recorded in the Kootenay Plains Ecological Reserve.
great gray owl	*Strix nebulosa*	B, C-V	Blue-listed by the province and designated as “vulnerable” by COSEWIC, this species is an uncommon inhabitant of western and northern Alberta. It occupies undistrubed boreal forest with natural openings. Heart of its range is in the foothills, however there are records of its occurrence near the Ecological Reserve.
rufus hummingbird	*Selasphorus rufus*	-	Fairly common summer resident of the mountain national parks, asthis is the only range for the species in Alberta. Mountain wildflower meadows and old burns with fireweed provide the required nectar-producing flowering plants. Breeding activity is documented in the Kootenay Plains Ecological Reserve.
belted kingfisher	*Ceryle alcyon*	-	Relatively common spring and summer resident throughout Alberta, from boreal forest to grassland. Nests in stream and river banks and is common all along the N. Sask. R. Likely nesting activity has been recorded in the area of the Kootenay Plains.
yellow-bellied sapsucker	*Sphyrapicus varius*	-	Relatively common in Alberta, however it reaches the western limits of its range near the Ecological Reserve. It is very rare in the Rocky Mountain region.
three-toed woodpecker	*Picoides tridactylum*	Y	Uncommon resident found predominantly in the foothills region. A bird of mature coniferous forest with interspersed open areas, nesting has been documented in the vicinity of the Kootenay Plains Ecological Reserve.
northern flicker	*Colaptes auratus*	-	Most widely distributed and well-known of Alberta’s woodpeckers. They are more common in southern than in northern Alberta, where they inhabit a range of niches including forest edges around wetlands and river valleys. Breeding records are confirmed within the Kootenay Plains Ecological Reserve.
pileated woodpecker	*Dryocopus pileatus*	Y	Distributed through the southern half of the province, this species has a preference for heavy stands of mature deciduous trees. The need for old-growth forests limits its available habitat immediately in the Kootenay Plains Ecological Reserve but it has been recorded in areas bordering the Reserve.

olive-sided flycatcher	*Contopus borealis*	-	Uncommon across its range in Alberta, which includes all wooded areas of the province (boreal forest, mountains, and foothills). Has been recorded in the Kootenay Plains Ecological Reserve near Abraham Lake and along the N. Sask. R., where semi-open coniferous and mixedwood forests provide suitable nesting habitat.
least flycatcher	*Empidonax minimus*	-	The smallest, most common and widely distributed of the Empidonax flycatchers in Alberta. Willow and aspen-dominated mixedwood forests are preferred nesting habitats of the species. It should be considered rare in the Rocky Mountains, as it is more common in the boreal forest and parkland regions.
dusky flycatcher	*Empidonax oberholseri*	-	Range lin Alberta is limited to the Rocky Mountains and foothills, where it is an uncommon summer resident. Willow thickets, riparian shrubs, and shrubby burns are preferred habtiats. It has been described from the Kootenay Plains Ecological Reserve.
Cordilleran flycatcher	*Empidonax difficilis*	-	Provincial breeding range limited to Rocky Mountains, where it is a rare summer resident. Usually found in riparian woodlands and other moist areas. Breeding has been recorded in the vicinity of the Ecological Reserve.
tree swallow	*Tachycineta bicolor*	-	Common and widely distributed across Alberta. Natural breeding habitat is mature woodlands, as the species is an obligate cavity nester. Abundant in that portion of the N. Sask. R. which flows through the Rocky Mountain and Foothills natural regions. Thus, species is well-documented from the Kootenay Plains Ecological Reserve.
northern rough-winged swallow	*Stelgidopteryx serripennis*	-	Most common in southern Alberta, more uncommon in mountains. A colony reported from soft earth creek banks in the Kootenay Plains Ecological Reserve. Water and open land are required for foraging.
cliff swallow	*Hirundo pyrrhonota*	-	Widely distributed within the province. Steep clay riverbanks, culverts, cliffs, etc. provide substrate necessary for over-hanging nests. Nests have been found in the vicinity of Abraham Lake.
barn swallow	*Hirundo rustica*	-	Very common in areas of high human habitation, less common in Rocky Mountain region. In isolated areas, it closely follows river valleys and the N. Sask. R. within the Kootenay Plains Ecological Reserve houses numerous nesting colonies.
gray jay	*Perisoreus canadensis*	-	A permanent resident of Alberta, this species is common to very common in the Rocky Mountains and foothills regions. Found in a variety of woodlands, including mixedwood froests and dense coniferous forests. Very abundant in the Kootenay Plains Ecological Reserve as well.
black-billed magpie	*Pica pica*	-	Very abundant in southern half of province. Distribution westward into the foothills and Rocky Mountains is limited largely to large river valleys. Therefore, it is reported from the Kootenay Plains Ecological Reserve and adjacent areas along the N. Sask. R.
American crow	*Corvus brachyrhynchos*	-	Distribution and abundance are similar to that of *P. pica*.
common raven	*Corvus corax*	-	Widespread throughout Alberta, breeding in all natural regions. However, it is much more abundant in the Rocky Mountains and foothills than *P. pica* or *C. brachyrhynchus*.
black-capped chickadee	*Parus atricapillus*	-	One of the most common songbirds in the province, it is a year-round resident in the foothills and in the central portion of the province. Observations have been made, but nesting not confirmed, from the Kootenay Plains Ecological Reserve area.
mountain chickadee	*Parus gambeli*	Y	Limited distribution in Alberta, with provincial range only in the Rocky Mountain region. These secondary cavity-nesters rely on old nesting cavities of woodpeckers. In the Rocky Mountain region, they are usually found near treeline but have been recorded nesting in abundance in the area of the Kootenay Plains Ecological Reserve also.

boreal chickadee	*Parus hudsonicus*	-	A permanent resident of the Rocky Mountains and foothills. Nesting occurs in cavities of coniferous trees, with spruce and fir the preferred species. It is very common in the river valley of the N. Sask. R.'s upper reaches and has been recorded from the Kootenay Plains Ecological Reserve.
red-breasted nuthatch	*Sitta canadensis*	-	A common resident breeder in the mountains and foothills of western Alberta. Exhibits a preference for multi-species coniferous stands as opposed to uniformly composed stands of lodgepole pine. As a result, the N. Sask. R. valley provides suitable habitat.
rock wren	*Salpinctes obsoletus*	-	Breeds in the grassland region and is common in river valleys of that region. Extralimital records of the species place a confirmed breeder near Abraham Lake. Howeever, the species' requirements for hot, dry habitats with large rock outcrops or sparsely vegetated valley walls prohibit a range extension this far north.
winter wren	*Troglodytes troglodytes*	Y	Occurs predominantly in the Rocky Mountains, where it is a forest-interior species with preferences for Engelmann spruce-subalpine fir forests. Individuals have been recorded from the shores of Abraham Lake and the N. Sask. R. valley near the Kootenay Plains Ecological Reserve.
golden-crowned kinglet	*Regulus satrapa*	-	Widespread throughout Alberta but most abundant in the foothills and Rocky Mountain regions. Numerous nests and sightings have been made in and near the Kootenay Plains Ecological Reserve, where mature spruce and conifer-dominated mixedwoods are preferred sites.
ruby-crowned kinglet	*Regulus calendula*	-	Distribution is similar to that of R. satrapa, with Rocky Mountain and foothill habitats being the stronghold of the species' range in Alberta. Lodgepole pine-dominated landscapes are preferred in the foothills but subalpine and montane habitats are also utilized. The species has been recorded from the Ecological Reserve.
mountain bluebird	*Sialia currucoides*	-	Distributed widely across the southern half of the province, including the Rocky Mountains, in open woodland areas with scattered trees. Obligate cavity nesters, therefore they require woodpecker and other holes for nesting. Nesting in the vicinity of the Kootenay Plains Ecological Reserve has been confirmed.
Townsend's solitaire	*Myadestes townsendii*	-	Range in Alberta is limited to the Rocky Mountain and foothills regions. They select open or broken spruce and fir forests, often on steep terrain. The slopes above Abraham Lake and the N. Sask. R., within the Kootenay Plains Ecological Reserve provide good habitat for this species outside of the alpine areas.
Swainson's thrush	*Catharus ustulatus*	-	Widespread distribution in Alberta, breeding in nearly all forested habitats, except in the grassland region. Prefers forest margins, wooded lakeshores and river banks. These habitats are where the species is found in the Kootenay Plains Ecological Reserve.
hermit thrush	*Catharus guttatus*	-	Widespread distribution similar to that of *C. ustulatus*. Reported as an uncommon spring and falll migrant and a common summer resident in the mountains where it also shares habitat niches with C. ustulatus.
American robin	*Turdus migratorius*	-	Human settlement and encroachment have allowed this species to become one of the most common avian species in Alberta. In the mountains, open subalpine forests had the highest densities of breeding robins. It is also common in the Kootenay Plains Ecological Reserve.
varied thrush	*Ixoreus naevius*	Y	A bird of limited range in Alberta, it is only found in the Rocky Mountain and foothill regions. Breeds predominantly in relatively mature coniferous stands and may use more habitats outside of the Ecological Reserve itself.
Bohemian waxwing	*Bombycilla garrulus*	-	Widely distributed across Alberta. Common residents in the Rocky Mountains, where they winter in the valleys and nest at higher elevations in the summer.

warbling vireo	*Vireo gilvus*	-	Widely distributed across Alberta from north to south and east to west. In the Rocky Mountains, shrubby avalanche slopes, thick aspen stands, and mixedwood forests are utilized. The species has been recorded from the Kootenay Plains Ecological Reserve.
solitary vireo	*Vireo solitarius*	-	An uncommon species that is widely distributed across forested regions of Alberta. In the Rocky Mountains, spruce and pine stands are predominantly used and the species has been observed in the vicinity of the Kootenay Plains, although nesting has not been confirmed.
Philadelphia vireo	*Vireo philadephicus*	-	Alberta's least known vireo, it is possible that this species reaches the extreme western and altitudinal limit of its Alberta range at Abraham Lake, where willow and alder thickets outlining the Lake and streams are likely used as nest sites.
orange-crowned warbler	*Vermivora celeta*	-	A common summer resident in the Rocky Mountains, this species prefers short brushy habitat such as willow and alder thickets. It has been recorded from a few locations in and near the Kootenay Plains Ecological Reserve.
yellow-rumped warbler	*Dendroica coronata*	-	One of the most common wood warblers in Canada, it is widespread in Alberta with a majority of breeding records coming from the Rocky Mountain and foothills regions. All kinds of coniferous woods are utilized in the vicinity of the Kootenay Plains.
MacGillivray's warbler	*Oporonis tolmei*	-	Records of this species in the Rocky Mountains represent the eastern range limit of this species. Areas with thick, dense brush and nearby water are preferred nesting areas; deciduous and riparian woodlands along streams are also used.
common yellowthroat	*Grothlypis trichas*	-	Widespread distribution throughout Alberta but more scarce on the prairie and in the higher elevations of the Rocky Mountains. Open marshy areas and low, tangled, scrubby vegetation along woodland edges are preferred habitats. While nesting has not been confirmed, this species has been recorded near Abraham Lake and N. Sask. R. in the vicinity of the Kootenay Plains Ecological Reserve.
Wilson's warbler	*Wilsonia pusilla*	-	Common summer resident in mountains, less common eslewhere in the province. High elevation burns and avalanche slopes are preferred in subalpine and alpine habitats, however, in the Kootenay Plains Ecological Reserve, willow alder thickets and other riparian vegetation associations are likely inhabited.
western tanager	*Piranga ludoviciana*	-	Widely distributed across the northern two-thirds of the province but is an uncommon summer resident in the Rocky Mountains. Kootenay Plains Ecological Reserve is one of the few confirmed breeding localities in the mountains, where it prefers open coniferous and mixedwood forests.
chipping sparrow	*Spizella passerina*	-	Common and abundant throughout most of its range in Alberta. Very adaptable to human settlement, so more common in southern Alberta. Nests in low bushes, vines, and lower branches of conifers close to open grassy areas. Many nests have been confirmed in the Kootenay Plains Ecological Reserve.
clay-colored sparrow	*Spizella pallida*	-	Stable populations in Alberta but is more common in the parkland and grassland than in the mountains. Preferences for open field and brushy edges restrict it to river valleys in the Rocky Mountain portion of its range and it has been observed in the N. Sask. R. valley in the Kootenay Plains Ecological Reserve.
Vesper sparrow	*Pooecetes gramineus*	-	A very common species in the Grassland region but it is generally restricted to river valleys when it occurs in the foothills and mountains. Foothill occurrences of this species are very rare due to preferences for open, dry situations. Such grassy plains are characteristic of the Kootenay Plains Ecological Reserve and breeders have been confirmed in the area.

savannah sparrow	*Passerculus sandwichensis*	-	Most widely distributed of the Alberta sparrows during the breeding season. In the mountains, it is most abundant in moist meadows and has been documented in appropriate wet habitats in the Ecological Reserve.
Lincoln's sparrow	*Melospiza lincolnii*	-	Very common in the mountains and foothills and slightly less common in other parts of its range in northern Alberta. Wet meadows, forest edges, bogs, and other riparian associations are where the species has been recorded in the study area, but breeding status has not been confirmed.
white-crowned sparrow	*Zonotrichia leucophrys*	-	One of the most common sparrows in western North America. Most common in the Rocky Mountain region, where it is found in thickets along woodland edges, valley floors, and shrubby meadows. Intense nesting activity has been documented in and around the Kootenay Plains Ecological Reserve.
dark-eyed junco	*Junco hyemalis*	-	A commonly observed nesting species that is widely distributed across Alberta. Found in coniferous and mixedwood forests where it nests on the ground, concealed in vegetation or debris. Also a very common nesting species in the Kootenay Plains Ecological Reserve.
brown-headed cowbird	*Molothrus ater*	-	Common throughout Alberta, this species has seen one of the greatest range expansions of any North American bird in the past 200 years. Forages on the ground and parastizes nests of songbirds in the area. A confirmed breeder in the Ecological Reserve.
white-winged crossbill	*Loxia leucoptera*	-	Fairly common resident in the Rocky Mountains and Boreal Forest regions, where it is usually a permanent, year-round resident. These granivores can be out-of-season nesters in all types of confierous forests, generally exhibiting a preference for spruce. Nesting has been confirmed in the Kootenay Plains Ecological Reserve.
pine siskin	*Carduelis pinus*	-	The most common bird observed in the Rocky Mountains during the summer. Both coniferous and mixedwood fprests are utilized. Nesting has not been confirmed for the Ecological Reserve, however sightings and probable nestings have been reported.

HERPETILES

spotted frog	*Rana pretiosa*	-	Limited distribution in Alberta; only in the Rocky Mountain region. Generally, even the observation of this species at Abraham Lake may be considered an eastern and elevational range limit, as it is more commonly found at approximately 2,000 masl.
western toad	*Bufo boreas*	-	Most common in the Rocky Mountains and foothills of Alberta, where it inhabits water-dominated sites and damp forested habitats. Overwinters under moss or underground. Documented from Abraham Lake and downstream in the N. Sask. R.

FISH

mountain whitefish	*Prosopium williamsoni*	-	Native and common to the N. Sask. R. but not found in the smaller tributaries. Shallow portions of Abraham Lake and river shallows are likely spawning areas in October or November.
lake trout	*Salvelinus namaycush*	-	Native to the N. Sask. R. drainage, where they tend to be restricted to relatively deep, cool lakes. Rocky or gravelly shoals provide spawning habitat in September or October.
bull trout	*Salvelinus confluentus*	-	Widest natural distribution of any fish species native to the area, however has seen drastic declines in eastern range limits in the past 10 years. A great deal of interaction is likely between fish of streams and mainr iver stems in the study area.

brook trout	*Salvelinus fontinalis*	-	Introduced in Banff in 1904 and in N. Sask. R. in study area in 1941. Now eidely distributed and quite common in Abraham Lake. Natural barriers (i.e., waterfalls, etc.) limit upstream movement to some streams, however, there has been extensive dispersal, movement, and recolonization by the stocked fish.
cutthroat trout	*Salmo clarkii*	-	Stocked in the upper N. Sask. R. in 1956 and is now widespread and established in the drainage. Late spring and early summer spawning sites are limited at these high elevations due to extreme spring flooding.
rainbow trout	*Salmo gairdnerii*	-	Numerous watersheds in and bordering the study area were stocked between 1934-1972. Species is well established in other drainages (upper Mistaya, upper Siffleur) but appears to be less well-suited for glacial systems than the cutthroat trout.
longnose sucker	*Catostomus catostomus*	-	Likely the most common fish species in the study area. Mostly inhabits Abraham Lake and the N. Sask. R. but not that common in tributaries.
white sucker	*Catostomus commersoni*	-	Relatively rare in the study area, this catostomid is found in rivers and lakes. Both clear and turbid creeks are used for spawning but suitable beach sites along Abraham Lake may also be used.
mountain sucker	*Catostomus platyrhychus*	-	Spawning fish have been noted in the lower reaches of Whiterabbit Creek. Commonly found in mountain streams in both clear and turbid waters. Normally avoids lakes and lake-like conditions, explaining relative rarity in Abraham Lake itself.
longnose dace	*Rhinichthys cataractae*	-	Endemic species which has been collected from the N. Sask. R. main stem and from side channels but not from any tributaries.
lake chub	*Couesius plumbeus*	-	Tolerates a wide variety of environments and is, therefore, widespread throughout Alberta, from the mountains to the grasslands. Spawning occurs from late June to mid-August in lakes and large rivers. Well-suited to life in reservoir systems and should be abundant in Abraham Lake.
spoonhead sculpin	*Cottus ricei*	-	The only species of cottid known from the area. They are likely restricted to the main river, its side channels, and the lower reaches of the larger tributaries.

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[1] ***Status*** refers to any special management designation given to a species, either on a provincial or a federal level. The codes used are as follows:

R: Provincially red-listed
B: Provincially blue-listed
Y: Provincially yellow-listed
C-V: COSEWIC (federal) vulnerable
C-T: COSEWIC (federal) threatened

APPENDIX 6

PHOTOGRAPHS OF REPRESENTATIVE FEATURES
OF THE
KOOTENAY PLAINS ECOLOGICAL RESERVE STUDY AREA

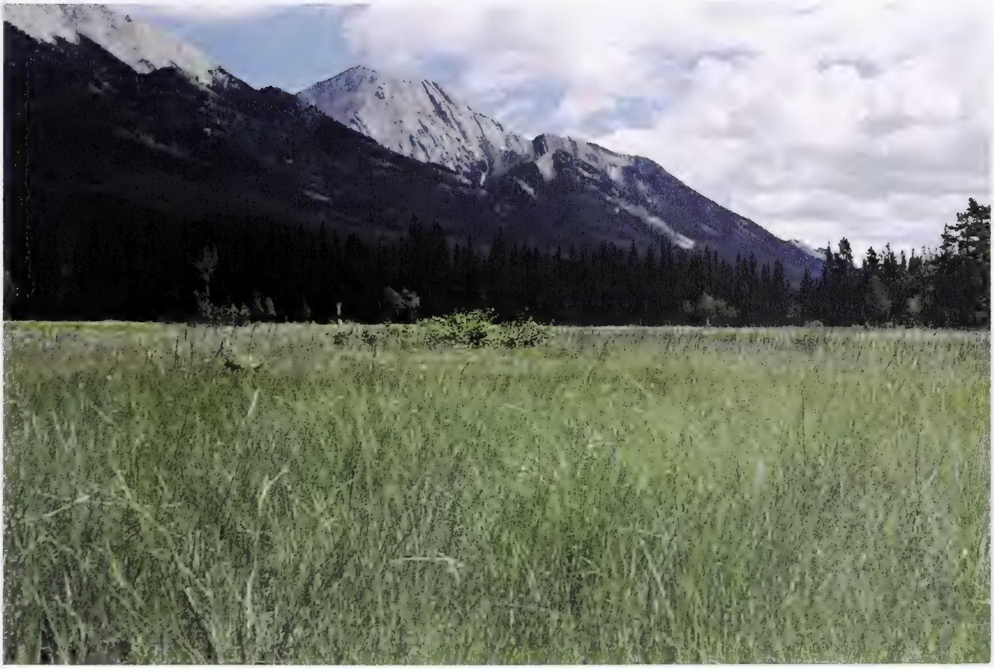


Plate 1: June Grass-awnless brome/pasture sagewort community type occurring on fluvial materials. This community is generally associated with disturbed and/or wetter grassland areas. Grasslands such as these are generally underlain by Orthic Humic Regosols, the dominant grassland soil found within the study area. This photo gives an example of an F1 ecosite.

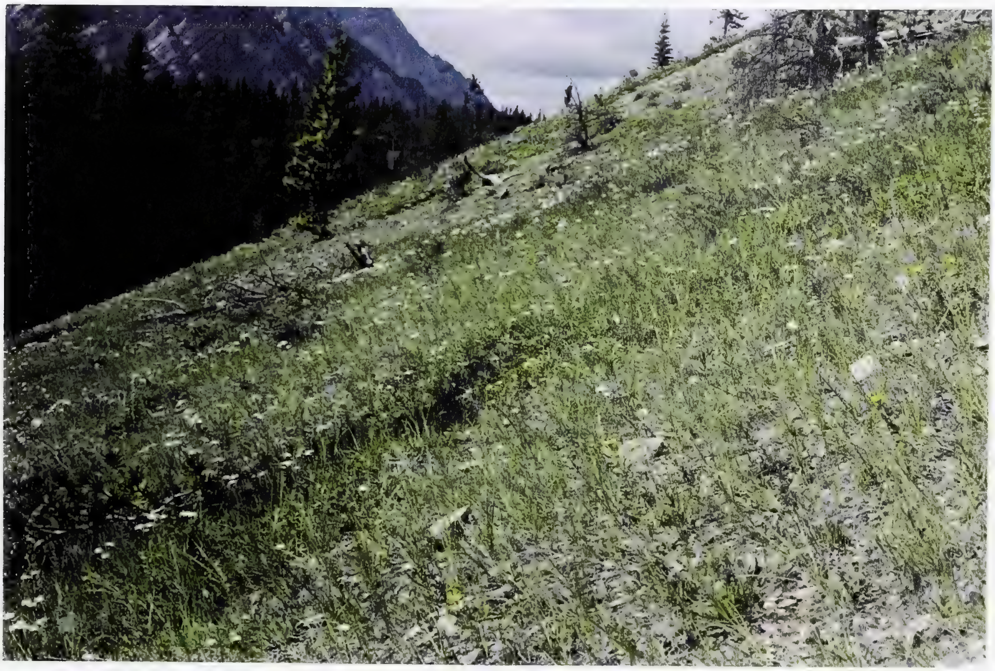


Plate 2: Limber pine/common bearberry/June grass community type occurring on glaciofluvial materials. Vegetative cover in this community type is generally low with high species diversity. This photo shows an example of the GF4 ecosite.

Plate 3: A lone limber pine (*Pinus flexis*) occurring within a Limber pine/common bearberry/June grass community. Limber pine in the area have been reported to be up to 1000 years old.

Plate 4: White spruce/water birch/common bearberry/simple bog sedge community type found on an organic veneer/glaciofluvial complex. Organic soils found within the study area are generally shallow and discontinuous, occurring as veneers adjacent to other poorly drained soils such as gleysols. This community type is generally associated with ecosite GFO1.

Plate 5: Forb and graminoid dominated communities interspersed with aspen stands are commonly associated with low lying alluvial materials within the ecological reserve.

Plate 6: Balsam poplar-white spruce /silverberry community type underlain by fluvial materials. Deciduous tree stands including this community type and the Aspen/Canada buffaloberry/hairy wild rye community type occur infrequently within the study area due to the lack of water availability. Thus, these sites are generally limited to stream channels or areas of high groundwater availability. This photo is characteristic of ecosite F3.

Plate 7: Glaciofluvial terraces (foreground) and the low lying North Saskatchewan River floodplain are the dominant landform features found within the Kootenay Plains Ecological Reserve.

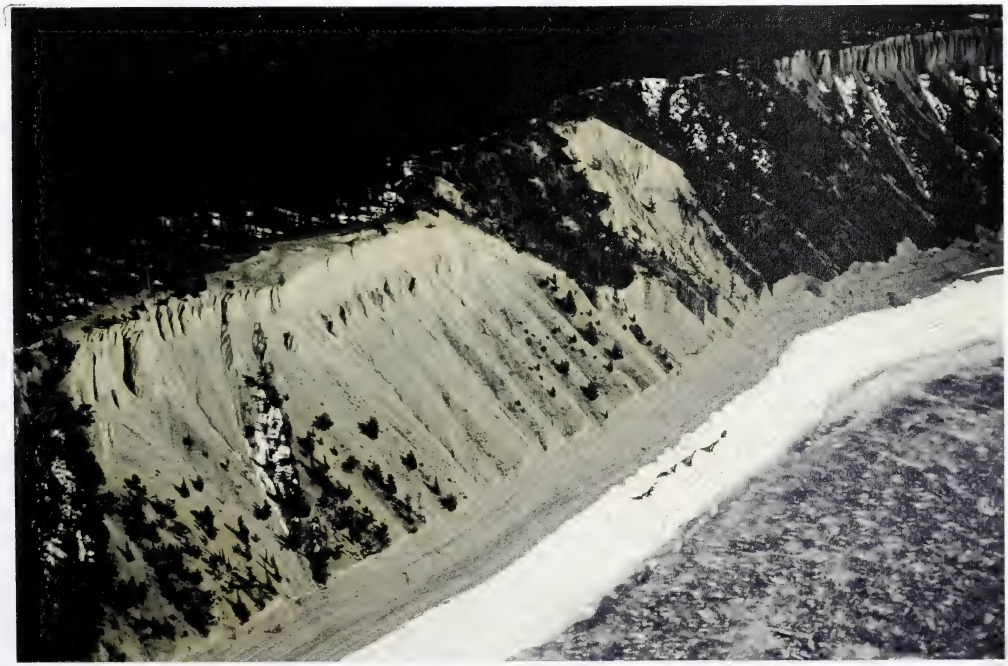


Plate 8: Active eroding glaciofluvial terraces provide potential nesting sites for cliff dwelling avian species such as cliff and northern rough-winged swallows. Shoreline striations in the foreground show the fluctuating water levels of Abraham Lake.

Plate 9: Forb-rich grasslands adjacent to steeply sloping terrain provide important food resources and escape routes for bighorn sheep.

Plate 10: Grasslands interspersed with woodlands provide important foraging areas juxtaposed with coniferous cover for the regions' ungulate population.

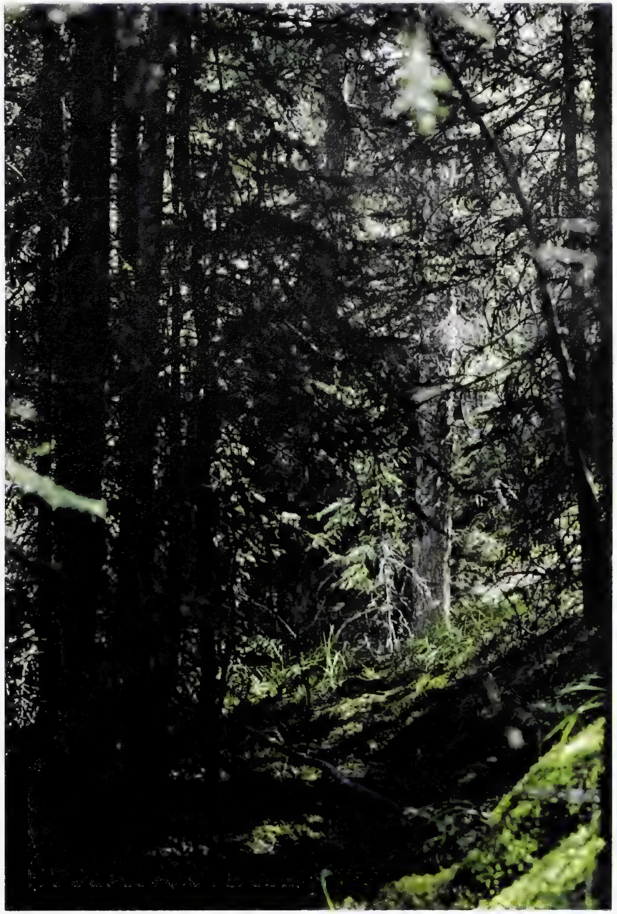


Plate 11: White spruce/Canada buffaloberry/feathermoss community type occurring on eolian veneers over glaciofluvial materials. This community commonly occurs on fans and floodplains throughout the study area. This community commonly occurs on the EGF2 ecosite.

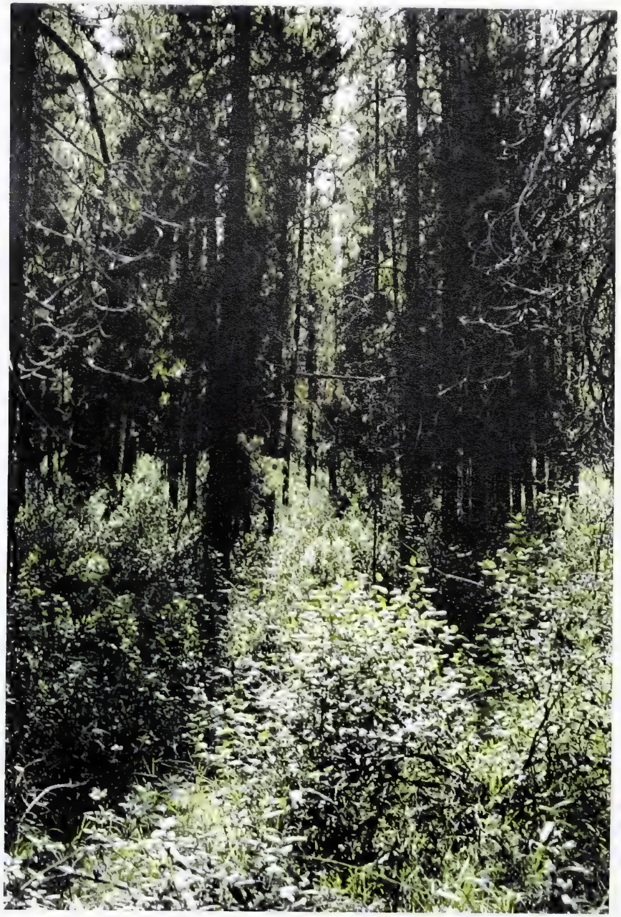


Plate 12: Lodgepole pine-white spruce/Canada buffaloberry-common bearberry community type underlain by glaciofluvial materials with eolian veneers. This community represents a transitional stage between the White spruce/Canada buffaloberry/feathermoss and the Lodgepole pine/Canada buffaloberry/hairy wild rye community types found within the study area.

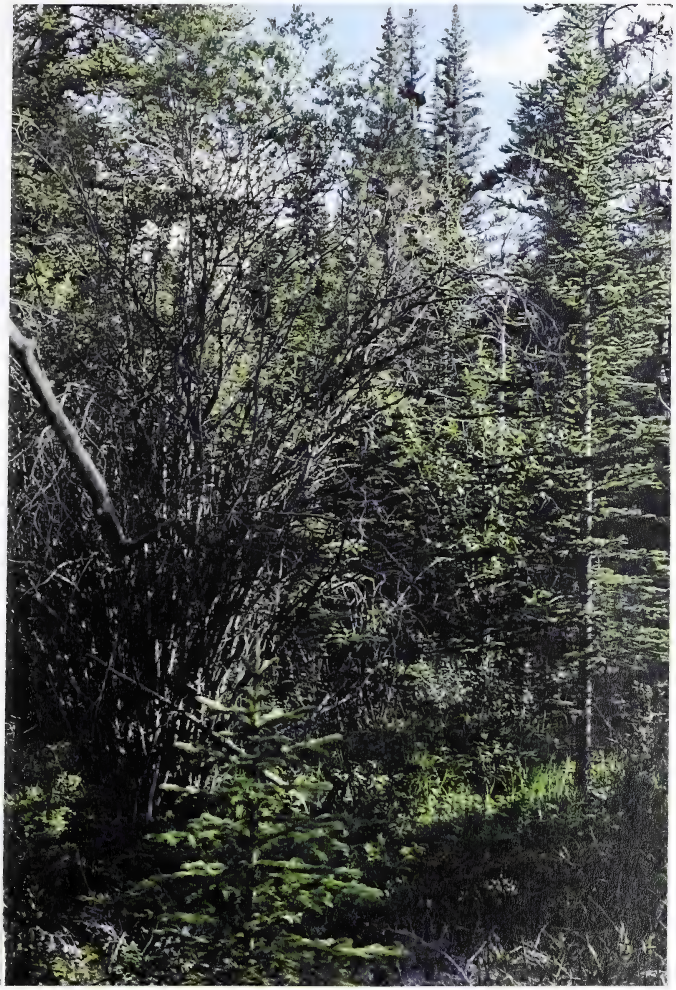


Plate 13: White spruce/Canada buffaloberry/feathermoss community type found on colluvial veneers and blankets. This photo is characteristic of ecosite C1 which is generally limited to the upper slopes of the ecological reserve.

APPENDIX 7

KOOTENAY PLAINS

ECOLOGICAL LAND CLASSIFICATION LEGEND

KOOTENAY PLAINS ECOLOGICAL LAND CLASSIFICATION LEGEND

ECOSITE	LANDFORM AND SURFICIAL MATERIALS	VEGETATION	SOIL CLASSIFICATION	SLOPE (%)	DRAINAGE CLASS	SURFACE TEXTURE	SUBSURFACE TEXTURE
COLLUVIAL							
C1	Colluvial veneers and blankets overlying moderately to steeply inclined rock and medium textured glaciofluvial deposits; moderately to very stony, often with non-stony eolian veneers	White spruce/Canada buffaloberry/feathermoss; Lodgepole pine/Canada buffaloberry/hairy wild rye	Orthic Eutric Brunisols; Orthic Regosols; Orthic Gray Luvisols	16- 45; 46- 70	Well to moderately well	Silt loam	Silt loam
C2	Ridged to inclined colluvial veneers with inclusions of inclined residual bedrock; isolated pockets of medium textured glaciofluvial materials; moderately to very stony; coarse textured	Lodgepole pine-limber pine/ common bearberry/northern wheatgrass; White spruce/Canada buffaloberry/feathermoss; Lodgepole pine/Canada buffaloberry/hairy wild rye Limber pine/common bearberry/June grass	Orthic Regosol	31- 70+	Well to moderately well	Sandy loam	Sandy loam
COLLUVIAL AND ROCK							
CR1	Discontinuous colluvial blankets and veneers over slightly to steeply inclined bedrock at upper elevations; medium textured	White spruce/Canada buffaloberry/feathermoss; White spruce/common bearberry/hairy wild rye; Lodgepole pine-white spruce/Canada buffaloberry-common bearberry; Lodgepole pine/Canada buffaloberry/hairy wild rye; Lodgepole pine-limber pine/ common bearberry/northern wheatgrass; shrubland; Sparsely vegetated by shrubs and lichens	Orthic Regosol; Orthic Eutric Brunisols; Rock and non-soil	31- 70+	Very rapidly to well	Sandy loam; rubbly and blocky	Sandy loam; rubbly and blocky

PERMEA-BILITY	DEPTH TO:			SURFACE ROCKINESS CLASS	SURFACE STONINESS CLASS	SHRINK-SWELL POTENTIAL	POTENTIAL FROST ACTION	FLOOD HAZARD
	BEDROCK	IMPERM. LAYER	WATER TABLE					
Moderate	>0	>0	>100	R2	S2	High	High	None
Moderate	>0	>0	>100	R2	S2	High	High	None
Moderate to Rapid	>0	>0	>100	R4	S4	Variable	Variable	None

EOLIAN AND GLACIOFLUVIAL							
EGF1	Discontinuous medium to coarse textured eolian veneers overlying level to terraced, medium to coarse textured glaciofluvial materials; inclusions of recent fluvial materials; isolated shallow organic deposits	Northern wheatgrass-June grass/pasture sagewort; Creeping juniper/northern wheatgrass-purple reed grass; Limber pine/common bearberry/June grass; Lodgepole pine-limber pine/common bearberry/northern wheatgrass; Lodgepole pine-white spruce/ Canada buffaloberry-common bearberry; White spruce/Canada buffaloberry/feathermoss; Lodgepole pine/Canada buffaloberry/hairy wild rye	Orthic and Eluviated Eutric Brunisols; Orthic and Cumulic Regosols; Orthic Humic Regosols; Orthic Humic Gleysols	0 - 9	Rapidly to very poorly	Silt to silt loam and sandy loam; mesic	Silt to silt loam; fine sandy loam to sand
EGF2	Discontinuous medium to coarse textured eolian veneers overlying inclined, coarse textured glaciofluvial materials; recent fluvial inclusions on lower slopes; inclusions of colluvium on steep terrace sidewalls	Northern wheatgrass-June grass/ pasture sagewort; June grass-awnless brome/pasture sagewort; White spruce/Canada buffaloberry /feathermoss; Limber pine/ common bearberry/June grass; Lodgepole pine-limber pine/ common bearberry/northern wheatgrass; Lodgepole pine-white spruce/ Canada buffaloberry-common bearberry; Lodgepole pine/ Canada buffaloberry/hairy wild rye	Orthic Eutric Brunisols, Orthic Humic Regosols; Orthic Regosols	10- 45 +	Well to moderately well	Silt to sandy loam	Sandy loam

Slow to Rapid	>100	>100	Variable	R0	S1	Moderate to High	Moderate to High	Rare to None
Moderate	>100	>100	>100	R0	S1	High	High	None

FLUVIAL							
F1	Inactive or periodically active, inclined fluvial fans and fluvial channels with dicontinuous eolian veneers ; medium to coarse textured; slightly to very stony; rare colluvial and fluvial veneers and blankets; rare bedrock outcrops; relict fluvial small coarse sand lenses; eolian loess deposits	White spruce/water birch/common bearberry/simple bog sedge; White spruce/Canada buffaloberry/ feathermoss; Northern wheatgrass-June grass/pasture sagewort; June grass-awnless brome/pasture sagewort; Aspen/Canada buffaloberry/hairy wild rye; Balsam poplar-white spruce/silverberry; Dwarf birch/sedge; Aspen/willow/ needle and thread; White spruce/ common bearberry/ northern wheatgrass	Orthic Eutric Brunisols; Orthic Humic Regosols; Orthic Regosols; Orthic Gleysols	0 - 45	Well to imperfectly	Silt to silt loam; sandy loam to loamy sand	Silt to silt loam; sandy loam to loamy sand
F2	Active or periodically active floodplains and low terraces, adjacent to high gradient, permanent streams; medium to coarse textured discontinuos eolian veneers; isolated organic veneers; rare fluvial veneers; braided river features on Siffleur River upstream of falls	White spruce/water birch/common bearberry/simple bog sedge; White spruce/ common bearberry/ northern wheatgrass; Balsam poplar-white spruce/silverberry; Lodgepole pine/ Canada buffaloberry/hairy wild rye; Northern wheatgrass-June grass/ pasture sagewort; Dwarf birch/ sedge; June grass-awnless brome/pasture sagewort; Creeping juniper/northern wheatgrass-purple reed grass; isolated graminoid dominated communities	Orthic Eutric Brunisols; Orthic Humic Gleysols; Orthic, Cumulic and Orthic Humic Regosols	0 - 5	Moderately well to imperfectly	Sandy loam to gravel; mesic	Sandy loam to gravel

Moderate	>100	>100	Variable	R0	S1	Moderate to High	Moderate to High	Rare to None
Moderate to Rapid	>100	>100	Variable	R0	S2	Variable	Variable	Variable
Moderate	>100	>100	>50	R0	S5	Variable	Variable	Frequent

F3	Low and moderate gradient small permanent and intermittent streams; includes active or periodically active braided channel deposits and floodplains; channel deposits generally excessively stony while bank deposits are typically coarse textured and exceedingly to excessively stony	White spruce/Canada buffaloberry/feathermoss; Balsam poplar-white spruce/silverberry; Dwarf birch/sedge; Sparsely vegetated; species include youngia and yellow mountain avens	Orthic Regosols; Orthic Humic Regosols; Orthic Humic Gleysols; nonsoil	0 - 15	Variable	Silt to loamy sand; gravels	Silt to loamy sand; gravels
F4	Moderate to high gradient, permanent streams with active floodplains; medium to coarse textured alluvial materials; includes both the North Saskatchewan and Siffleur Rivers and Whiterabbit Creek; occasional shallow organic deposits	Sparsely vegetated; June grass-awnless brome/ pasture sagewort; Dwarf birch/sedge; shrubland; isolated graminoid dominated communities	Orthic Regosols and Orthic Humic Regosols	0 - 2.5	Variable	Silt to loamy sand; mesic; gravel	Silt to loamy sand; gravel
FLUVIAL AND ROCK							
FR1	Steeply inclined bedrock and sporadic glaciofluvial veneers; Siffleur River Falls and canyon	none	Orthic Regosol; rock and non-soil	46-70	Very rapidly to well	Sandy loam; rubbly	Sandy loam; rubbly

Moderate	>100	>100	Variable	RO	S1	High	High	Infrequent to Frequent
Moderate	>100	>100	Variable	RO	S5	Variable	Variable	Frequent
Slow to Moderate	>50	>50	Variable	RO	S1	Moderate to High	Moderate to High	Rare to None
Moderate	>100	>100	>100	RO	S4	Moderate to High	Moderate to High	None

GLACIOFLUVIAL							
GF1	Level to terraced, medium to coarse textured glaciofluvial materials; inclusions of recent fluvial materials on lower slopes; occasional shallow organic deposits	Limber pine/common bearberry /June grass; Lodgepole pine/ Canada buffaloberry/hairy wild rye; Creeping juniper/northern wheatgrass-purple reed grass	Orthic Eutric Brunisols; Orthic Regosols; Orthic Humic Regosols; Orthic Humic Gleysols	0 - 9	Well to moderately well	Silt loam to sandy loam; mesic	Silt loam; sandy loam to loamy sand
GF2	Inclined, coarse textured glaciofluvial materials; inclusions of recent fluvial materials on lower slopes and colluvial materials on steep terrace sidewalls	Limber pine/common bearberry/June grass; Lodgepole pine-limber pine/common bearberry/northern wheatgrass; Lodgepole pine/Canada buffaloberry/hairy wild rye; Lodgepole pine-white spruce/ Canada buffaloberry-common bearberry; Creeping juniper/ northern wheatgrass-purple reed grass;	Orthic Eutric Brunisols; Orthic Regosols; Orthic Gray Luvisols; Rock and non-soil	10 - 45+	Well to moderately well	Silt loam; sandy loam to loamy sand	Silt loam; sandy loam to loamy sand
GF3	Eroded and gullied, moderately to steeply inclined glaciofluvial materials; generally terraced sidewalls	Limber pine/common bearberry/June grass;Lodgepole pine-limber pine/common bearberry/northern wheatgrass; Lodgepole pine/Canada buffaloberry/hairy wild rye; Creeping Juniper/northern wheatgrass-purple reed grass; shrubland	Orthic Regosols; Orthic Eutric Brunisols	16 - 45+	Very rapidly to well	Silt loam to sandy loam	Silt loam; sandy loam to loamy sand
GF4	Level to inclined meltwater channels and fans; medium to coarse textured glaciofluvial deposits with discontinuous eoilan veeners	Lodgepole pine/Canada buffaloberry/hairy wild rye; Lodgepole pine-white spruce/ Canada buffaloberry-common bearberry; White spruce/Canada buffaloberry /feathermoss	Orthic Eutric Brunisols	0 - 30	Well to moderately well	Silt loam; sandy loam to loamy sand	Silt loam; sandy loam to loamy sand

Moderate	>100	>100	>100	R0	Variable	Moderate to High	Moderate to High	None
Moderate	>100	>100	>100	R0	S1	Moderate to High	Moderate to High	None
Slow to Moderate	>100	>100	Variable	R0	S2	Moderate to High	Moderate to High	None
Moderate	>100	>100	>100	R0	S1	High	High	None

GLACIOFLUVIAL AND ORGANIC							
GFO1	Level to terraced, medium to coarse textured glaciofluvial materials with isolated, shallow organic deposits in depressional areas; discontinuous eolian veneers	Lodgepole pine/Canada buffaloberry/hairy wild rye; White spruce/water birch/common bearberry/simple bog sedge; Dwarf birch/sedge; graminoid dominated communities	Orthic Eutric Brunisols; Orthic Humic Gleysols; Orthic Humic Regosols; Terric Mesisols	0 - 5	Moderately well to very poorly	Silt and sandy loam to loam; mesic	Silt loam; sandy loam to loamy sand
MORAINE							
M1	Ridged to steeply inclined morainal deposits; medium to coarse textured; very to exceeding stony; often with thin non-stony eolian veneers; microdepressions in high water table areas	Lodgepole pine/Canada buffaloberry/hairy wild rye; Lodgepole pine-white spruce/Canada buffaloberry-common bearberry; White spruce/Canada buffaloberry/feathermoss; White spruce/common bearberry/northern wheatgrass	Orthic Eutric Brunisols; Orthic Regosols	5 - 45	Rapidly to imperfectly	Silt loam to sandy loam	Silt to sandy loam
MORAINE AND GLACIOFLUVIAL							
MGF1	Ridged to steeply inclined morainal deposits; medium to coarse-textured; very to exceedingly stony; contains minor glaciofluvial channels with coarse-textured material and inactive fluvial processes	Lodgepole pine/Canada buffaloberry/hairy wild rye; Willow/ Canada buffaloberry/hairy wild rye	Orthic Eutric Brunisols; Orthic Regosols; Gleyed Eutric Brunisols	5 - 30	Very well to imperfectly drained	Silt loam to sandy loam; silt clay loam	Silt clay loam to sandy loam
MORAINE AND ROCK							
MR1	Thin morainal veneers over slightly inclined bedrock; medium to coarse-textured; very to exceedingly stony	Lodgepole pine-white spruce/Canada buffaloberry-common bearberry	Orthic Eutric Brunisols	5 - 15	Very well to rapidly	Sandy loam	Sandy loam

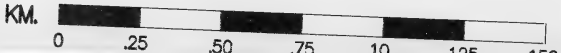
Moderate	>100	>100	Variable	R0	Variable	Moderate to High	Moderate to High	Frequent
Moderate	>100	>100	>100	R0	S1	High	High	None

MR2	Thin moraine veneers on ridged bedrock; medium to coarse textured; very to exceedingly stony; lacks glaciofluvial erosional features	Open canopy lodgepole pine/ Canada buffaloberry - common bearberry ; Lodgepole pine - white spruce/ Canada buffaloberry - common bearberry	Orthic Regosols; Orthic Eutric Brunisols	16 - 45	Well to rapidly	Sandy loam to silt loam	Sandy loam
ORGANICS							
O1	Shallow organic deposits over lacustrine veneers in moraine and glaciofluvial deposits; thin or lacking organic horizon	Bog birch/ sedge/ sphagnum ; willow/ Canada buffaloberry/ hairy wild rye	Terric mesosols; Rego gleysols	0 - 9	Very poorly	Clay loam to silt loam	Sandy clay loam
ROCK							
R1	Steeply inclined bedrock	Lodgepole pine - limber pine/ common bearberry/ June grass	Orthic Regosol; rock and non-soil	31 - 70	Very well to rapidly	Sandy loam	Sandy loam

MAP 1

KOOTENAY PLAINS ECOLOGICAL RESERVE

BIOPHYSICAL AREAS MAP



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MAP 1

KOOTENAY PLAINS ECOLOGICAL RESERVE

BIOPHYSICAL AREAS MAP

KM. 0 .25 .50 .75 1.0 1.25 1.50

SCALE - 1:20,000

MAP FEATURES

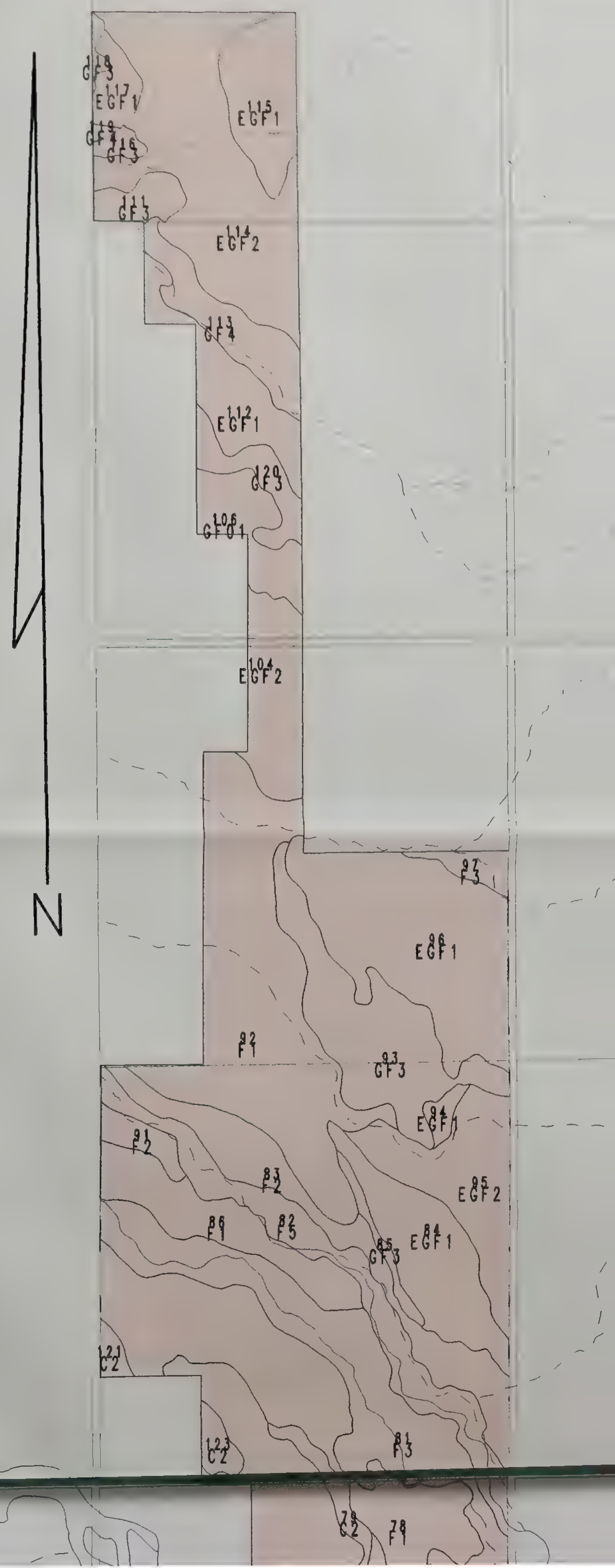
SECTION GRID
TOWNSHIP GRID
MAJOR HYDROGRAPHY
MINOR HYDROGRAPHY
WILDERNESS BOUNDARY

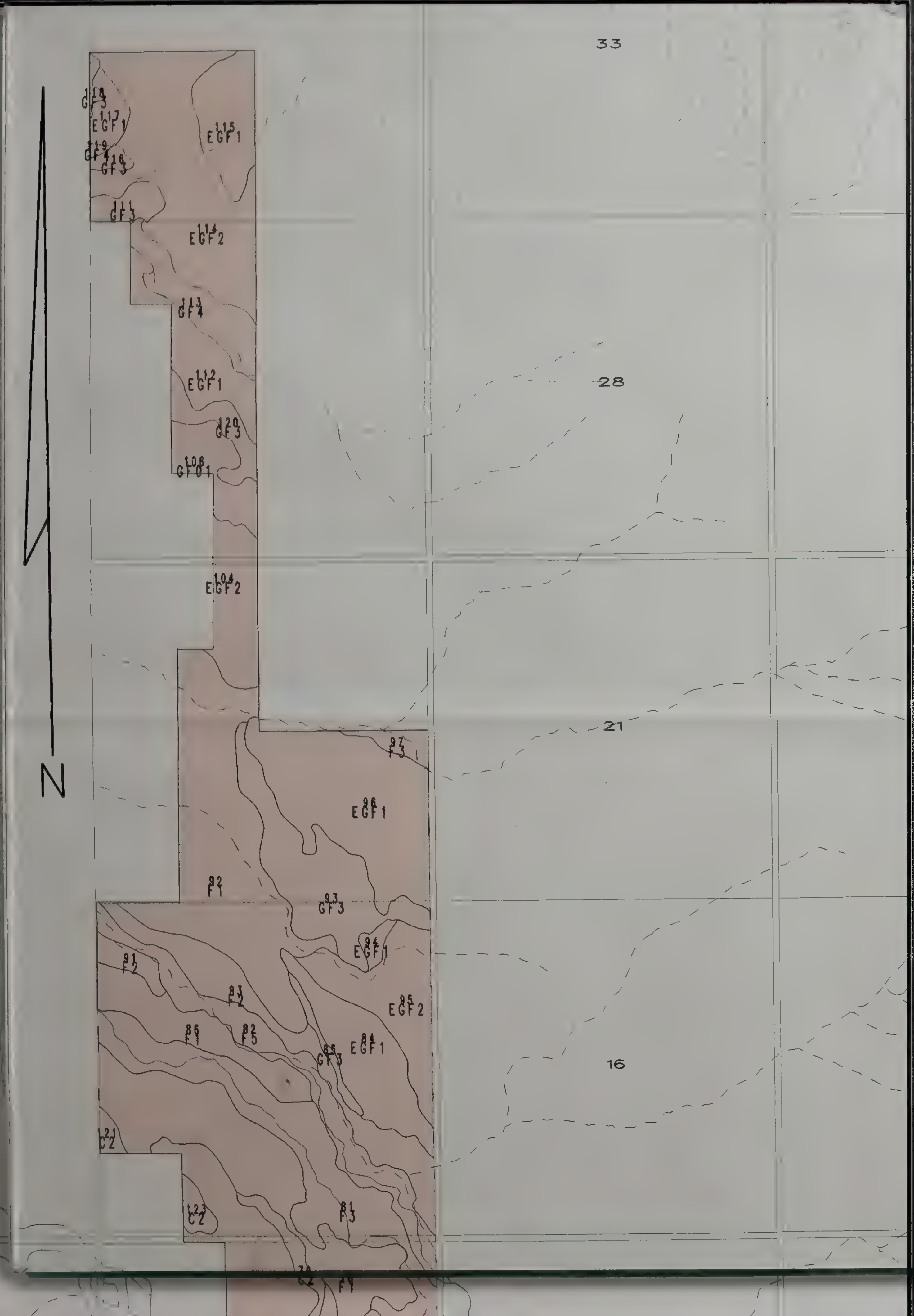
ECOSITE CODE

eg. EGF1, MR1

POLYGON NUMBER

eg. 84, 133



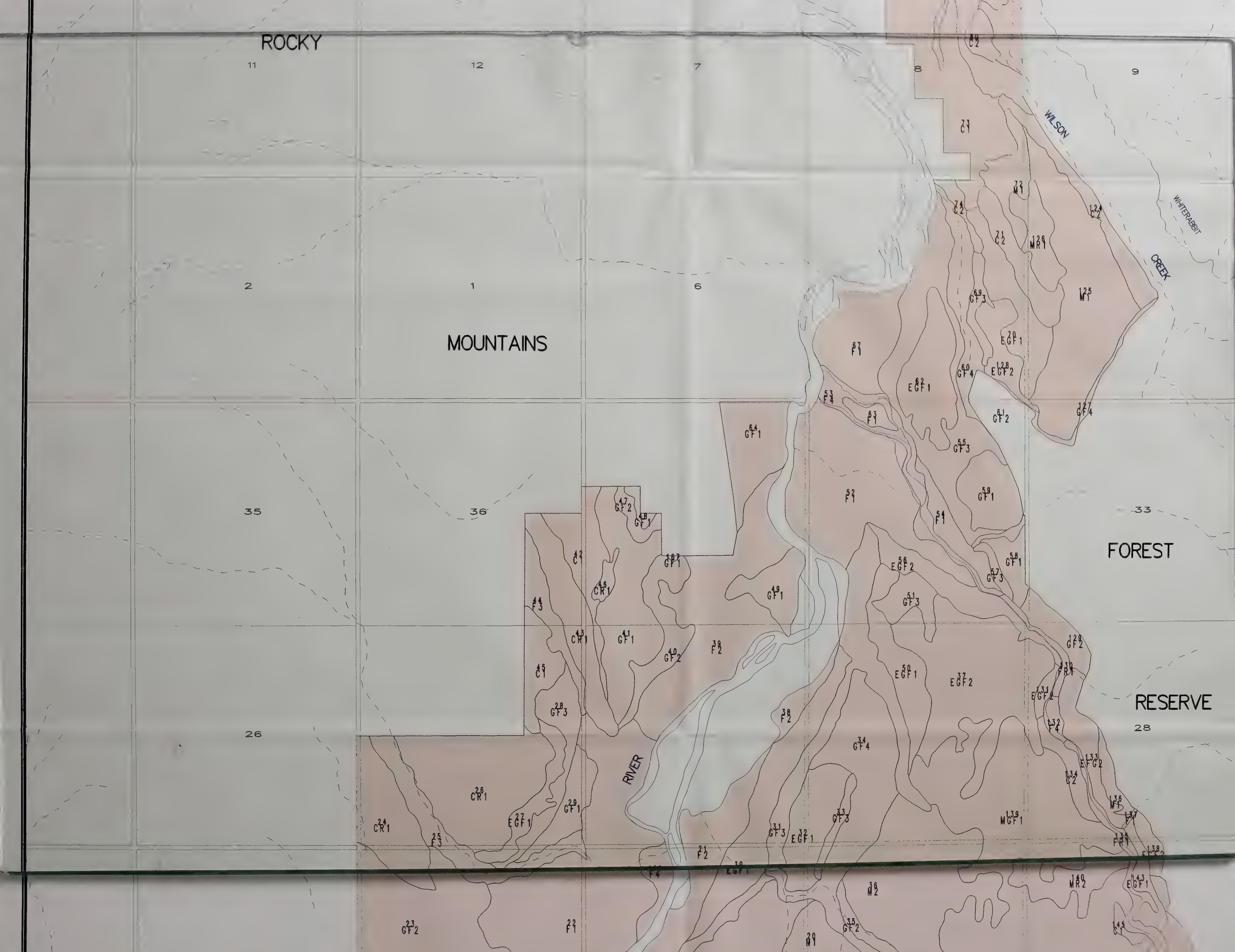


BIOPHYSICAL MAP

ABBREVIATED LEGEND

* See APPENDIX 7 for Ecological Land Classification Extended Legend

ECOSITE	LANDFORM AND SURFICIAL MATERIALS
COLLUVIAL	
C1	Colluvial veneers and blankets overlying moderately to steeply inclined rock and medium textured glaciofluvial deposits; moderately to very stony, often with non-stony eolian veneers
C2	Ridged to inclined colluvial veneers with inclusions of inclined residual bedrock; isolated pockets of medium textured glaciofluvial materials; moderately to very stony; coarse textured
COLLUVIAL AND ROCK	
CR1	Discontinuous colluvial blankets and veneers over slightly to steeply inclined bedrock at upper elevations; medium textured
EOLIAN AND GLACIOFLUVIAL	
EGF1	Discontinuous medium to coarse textured eolian veneers overlying level to terraced, medium to coarse textured glaciofluvial materials; inclusions of recent fluvial materials; isolated shallow organic deposits
EGF2	Discontinuous medium to coarse textured eolian veneers overlying inclined, coarse textured glaciofluvial materials; recent fluvial inclusions on lower slopes; inclusions of colluvium on steep terrace sidewalls
FLUVIAL	
F1	Inactive or periodically active, inclined fluvial fans and fluvial channels with discontinuous eolian veneers; medium to coarse textured; slightly to very stony; rare colluvial and fluvial veneers and blankets; rare bedrock outcrops; relict fluvial small coarse sand lenses; eolian loess deposits
F2	Active or periodically active floodplains and low terraces, adjacent to high gradient, permanent streams; medium to coarse textured discontinuous eolian veneers; isolated organic veneers; rare fluvial veneers; braided river features on Siffleur River upstream of falls
F3	Low and moderate gradient, small permanent and intermittent streams; includes active or periodically active braided channel deposits and floodplains; channel deposits generally excessively stony while bank deposits are typically coarse textured and exceedingly to excessively stony
F4	Moderate to high gradient, permanent streams with active floodplains; medium to coarse textured alluvial materials; includes both the North Saskatchewan and Siffleur Rivers and Whiterabbit Creek; occasional shallow organic deposits
FLUVIAL AND BEDROCK	


ROCKY
MOUNTAINS
FOREST
RESERVE
WILSON
CREEK
WHITERABBIT
RIVER
11
12
7
8
9
2
1
6
35
36
33
26
28
C2
C1
M1
C2
C2
MR1
C2
GF3
M1
EGF1
F1
EGF1
GF4
EGF2
F4
F1
GF2
GF4
GF1
GF3
F1
GF1
F1
GF2
GF1
C1
GF1
CR1
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EGF2
GF3
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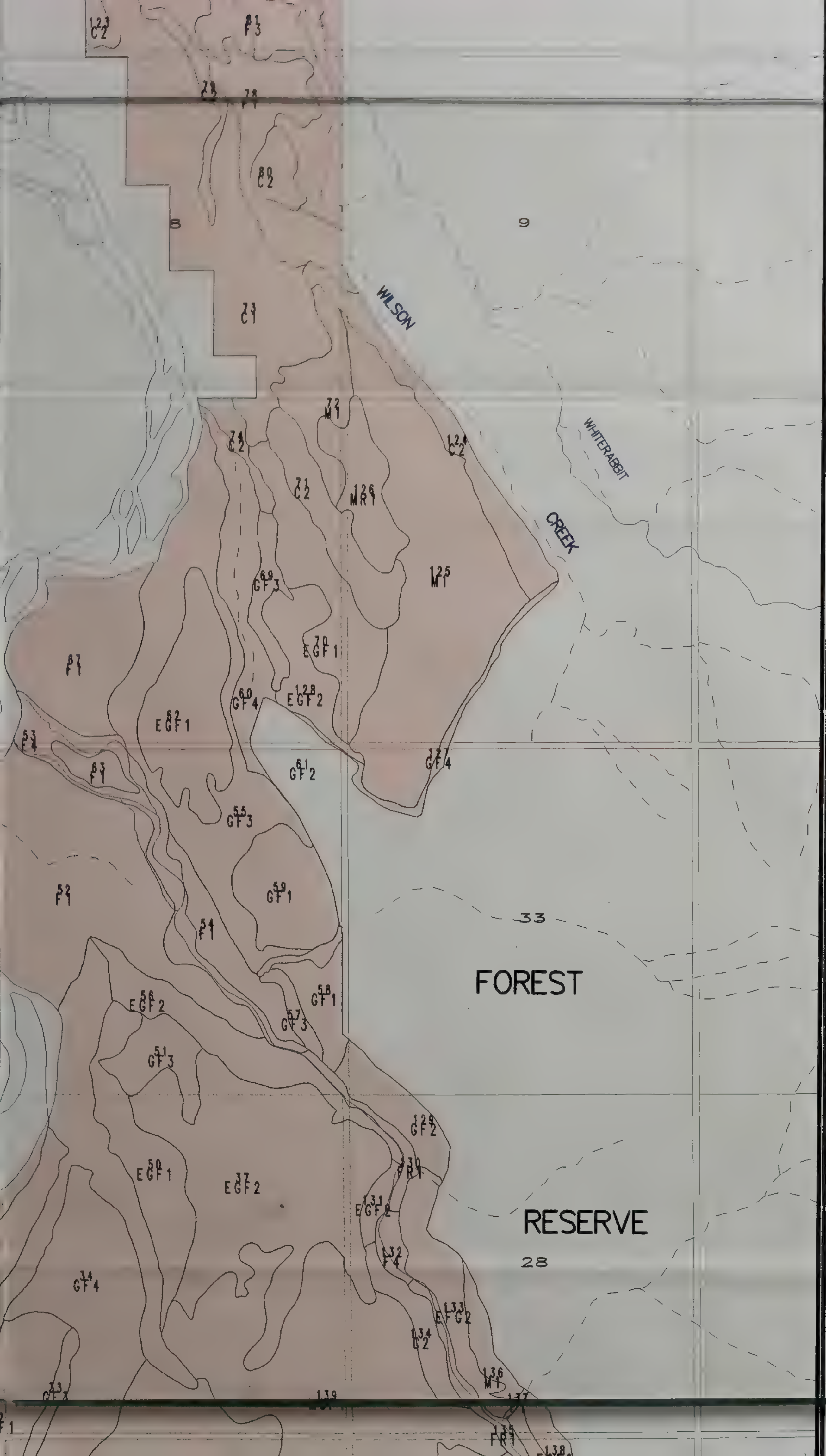
F1
M1
GF2
C1



F4	Moderate to high gradient, permanent streams with active floodplains; medium to coarse textured alluvial materials; includes both the North Saskatchewan and Siffleur Rivers and Whiterabbit Creek; occasional shallow organic deposits

FLUVIAL AND BEDROCK

FR1	Steeply inclined bedrock and sporadic glaciofluvial veneers; Siffleur River Falls and canyon

GLACIOFLUVIAL

GF1	Level to terraced, medium to coarse textured glaciofluvial materials; inclusions of recent fluvial materials on lower slopes; occasional shallow organic deposits
GF2	Inclined, coarse textured glaciofluvial materials; inclusions of recent fluvial materials on lower slopes and colluvial materials on steep terrace sidewalls
GF3	Eroded and gullied, moderately to steeply inclined glaciofluvial materials; generally terraced sidewalls
GF4	Level to inclined meltwater channels and fans; medium to coarse textured glaciofluvial deposits with discontinuous eolian veneers

GLACIOFLUVIAL AND ORGANIC

GFO1	Level to terraced, medium to coarse textured glaciofluvial materials with isolated, shallow organic deposits in depressional areas; discontinuous eolian veneers

MORAINE

M1	Ridged to steeply inclined morainal deposits; medium to coarse textured; very to exceedingly stony; often with thin non-stony eolian veneers; microdepressions in high water table areas

MORAINE AND GLACIOFLUVIAL

MGF1	Ridged to steeply inclined morainal deposits; medium to coarse textured; very to exceedingly stony; contains minor glaciofluvial channels with coarse textured material and inactive fluvial processes

MORAINE AND BEDROCK

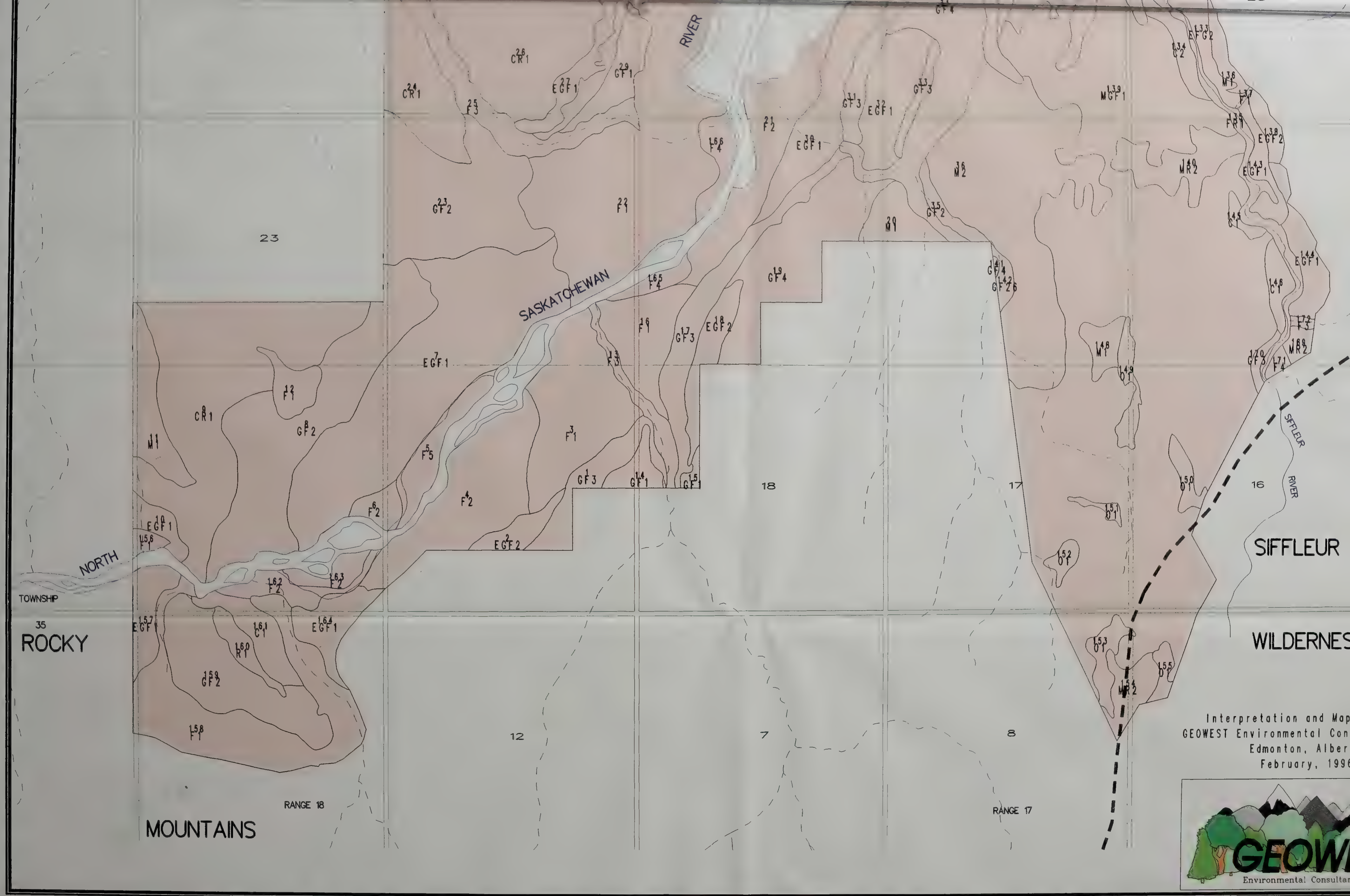
MR1	Thin morainal veneers over slightly inclined bedrock; medium to coarse textured; very to exceedingly stony
MR2	Thin morainal veneers on ridged bedrock; medium to coarse textured; very to exceedingly stony; lacks glaciofluvial erosional features

BEDROCK

R1	Bedrock

ORGANICS

O1	Shallow organic deposits over lacustrine veneers in morainal and glaciofluvial deposits; thin or lacking organic horizon


NORTH
SASKATCHEWAN
RIVER
SIFFLEUR
RIVER
SIFFLEUR
WILDERNES
ROCKY
MOUNTAINS
TOWNSHIP
35
RANGE 18
RANGE 17
23
18
17
16
12
7
8
CR1
GF2
M1
F1
EGF1
F5
F2
F3
GF3
GF4
M2
MR2
MGF1
O1
C1
R1
Interpretation and Map
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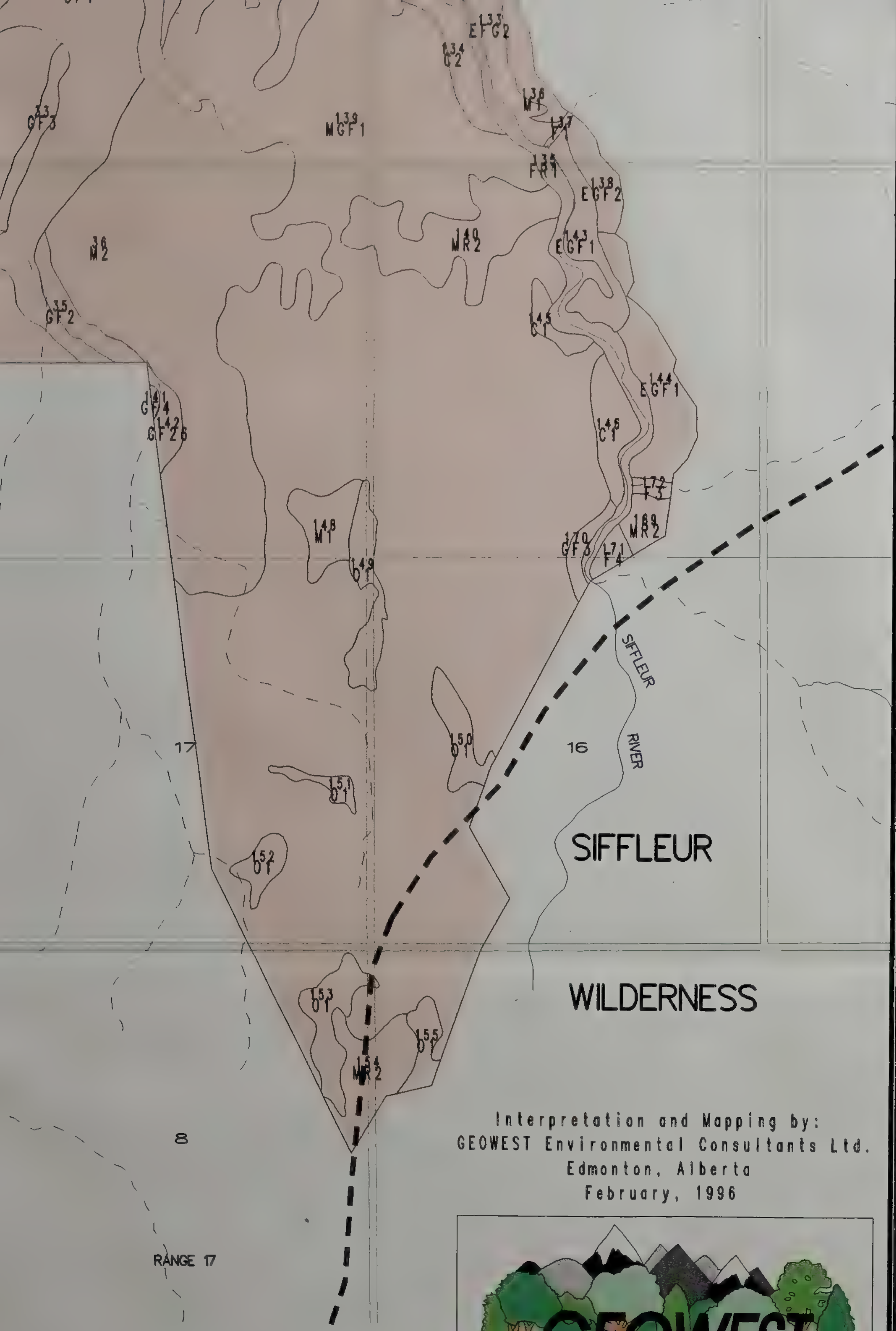
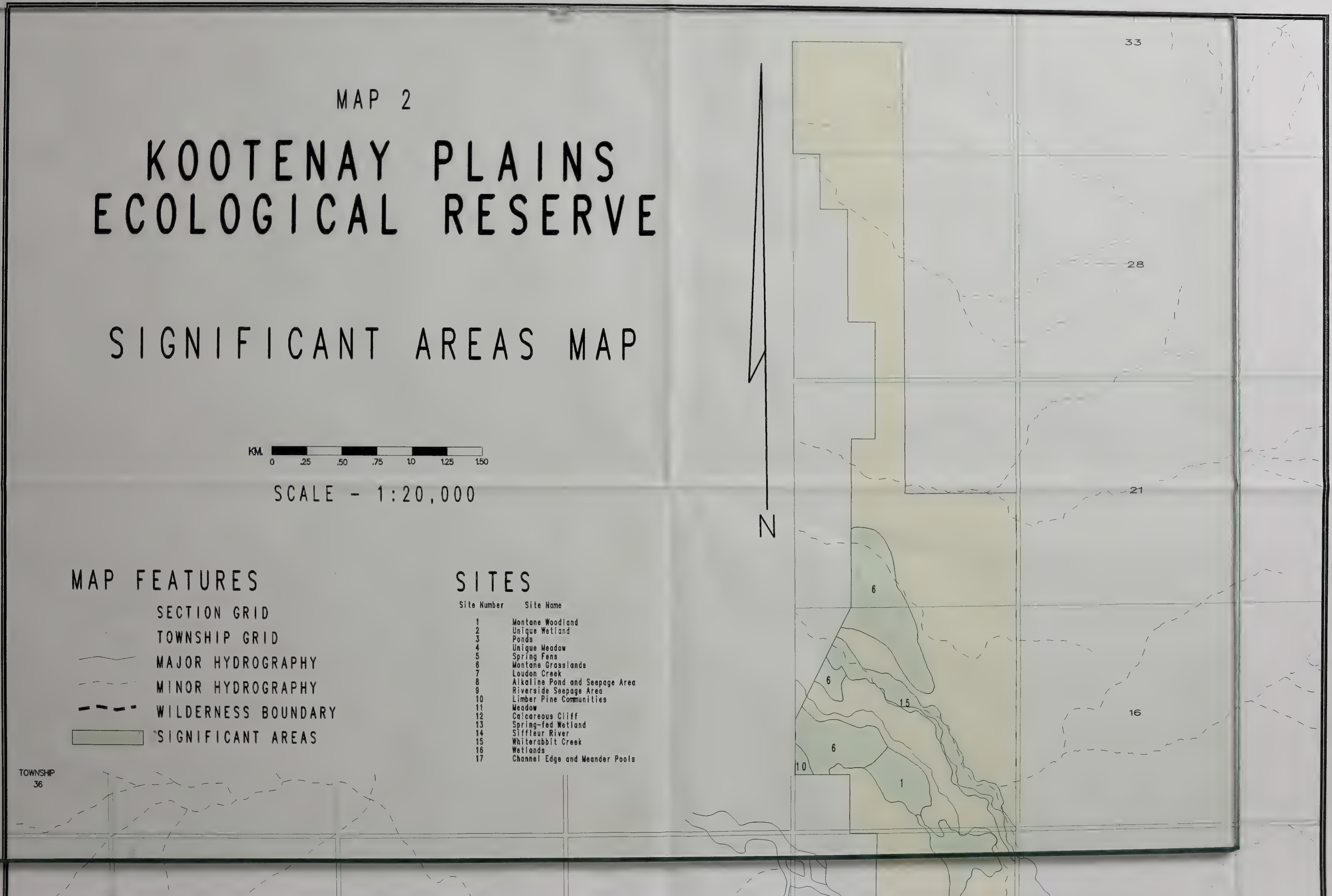


Interpretation and Mapping by:
GEOWEST Environmental Consultants Ltd.
Edmonton, Alberta
February, 1996

GEOWEST
Environmental Consultants Ltd.

ORGANICS

O1	Shallow organic deposits over lacustrine veneers in morainal and glaciofluvial deposits; thin or lacking organic horizon



MAP 2

KOOTENAY PLAINS ECOLOGICAL RESERVE

SIGNIFICANT AREAS MAP

KM. 0 .25 .50 .75 1.0 1.25 1.50

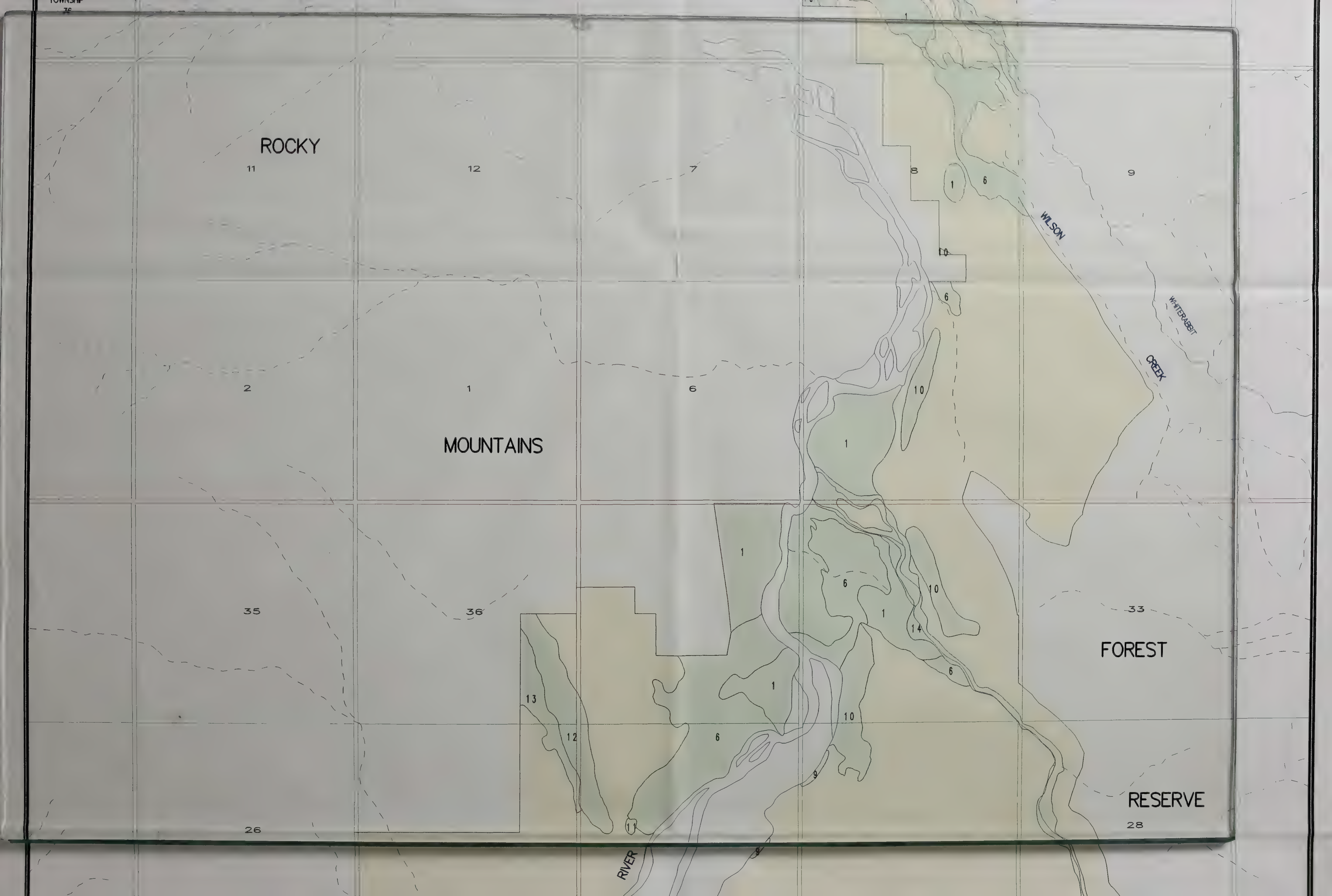
SCALE - 1:20,000

MAP FEATURES

- SECTION GRID
- TOWNSHIP GRID
- MAJOR HYDROGRAPHY
- MINOR HYDROGRAPHY
- WILDERNESS BOUNDARY
- SIGNIFICANT AREAS

SITES

Site Number	Site Name
1	Montane Woodland
2	Unique Wetland
3	Ponds
4	Unique Meadow
5	Spring Fens
6	Montane Grasslands
7	Loudon Creek
8	Alkaline Pond and Seepage Area
9	Riverside Seepage Area
10	Limber Pine Communities
11	Meadow
12	Calcareous Cliff
13	Spring-fed Wetland
14	Siffleur River
15	Whiterabbit Creek
16	Wetlands
17	Channel Edge and Meander Pools


ROCKY
MOUNTAINS
FOREST
RESERVE
WILSON
CREEK
WHITERABBIT
RIVER
11
12
7
8
9
2
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6
35
36
33
26
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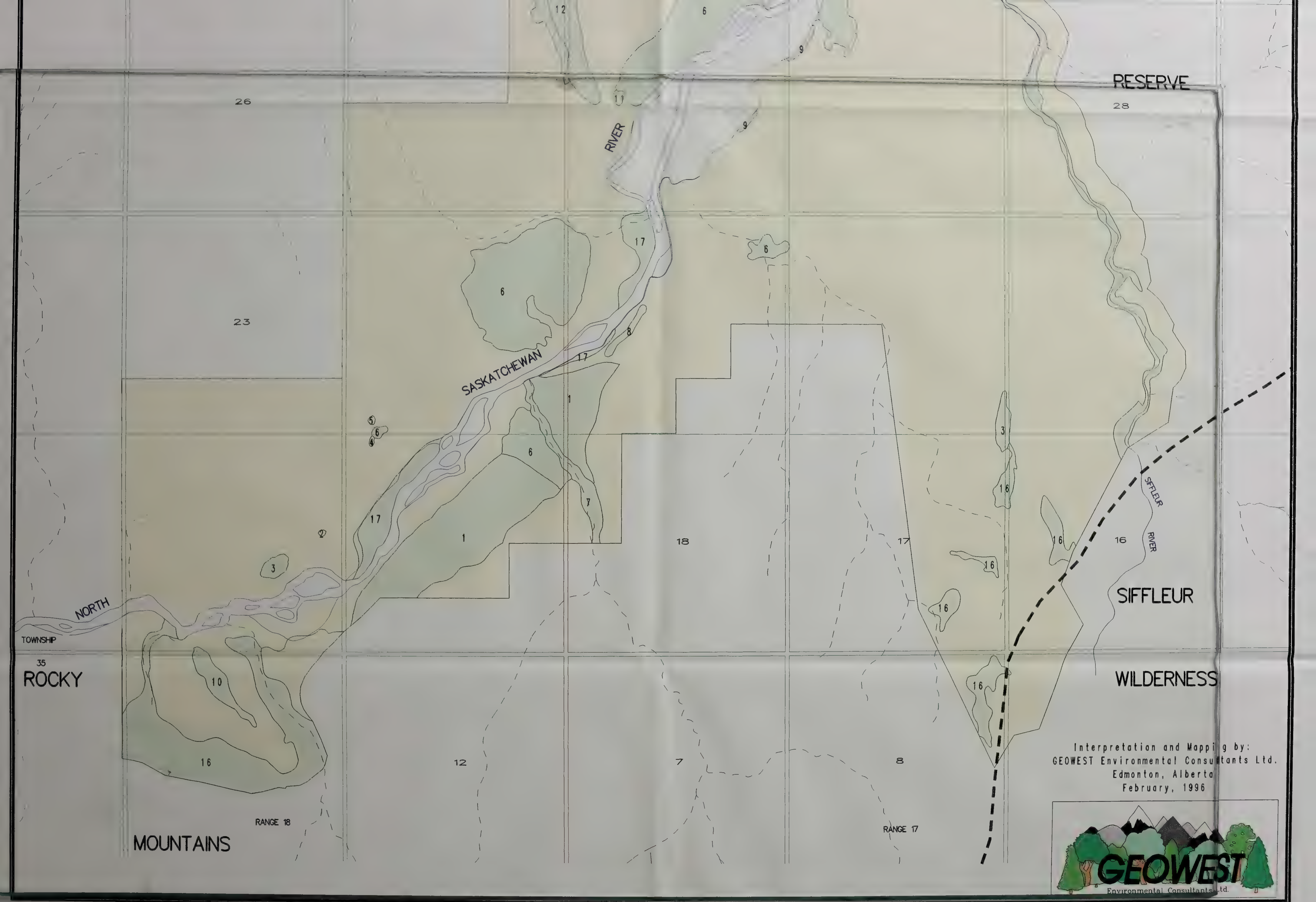
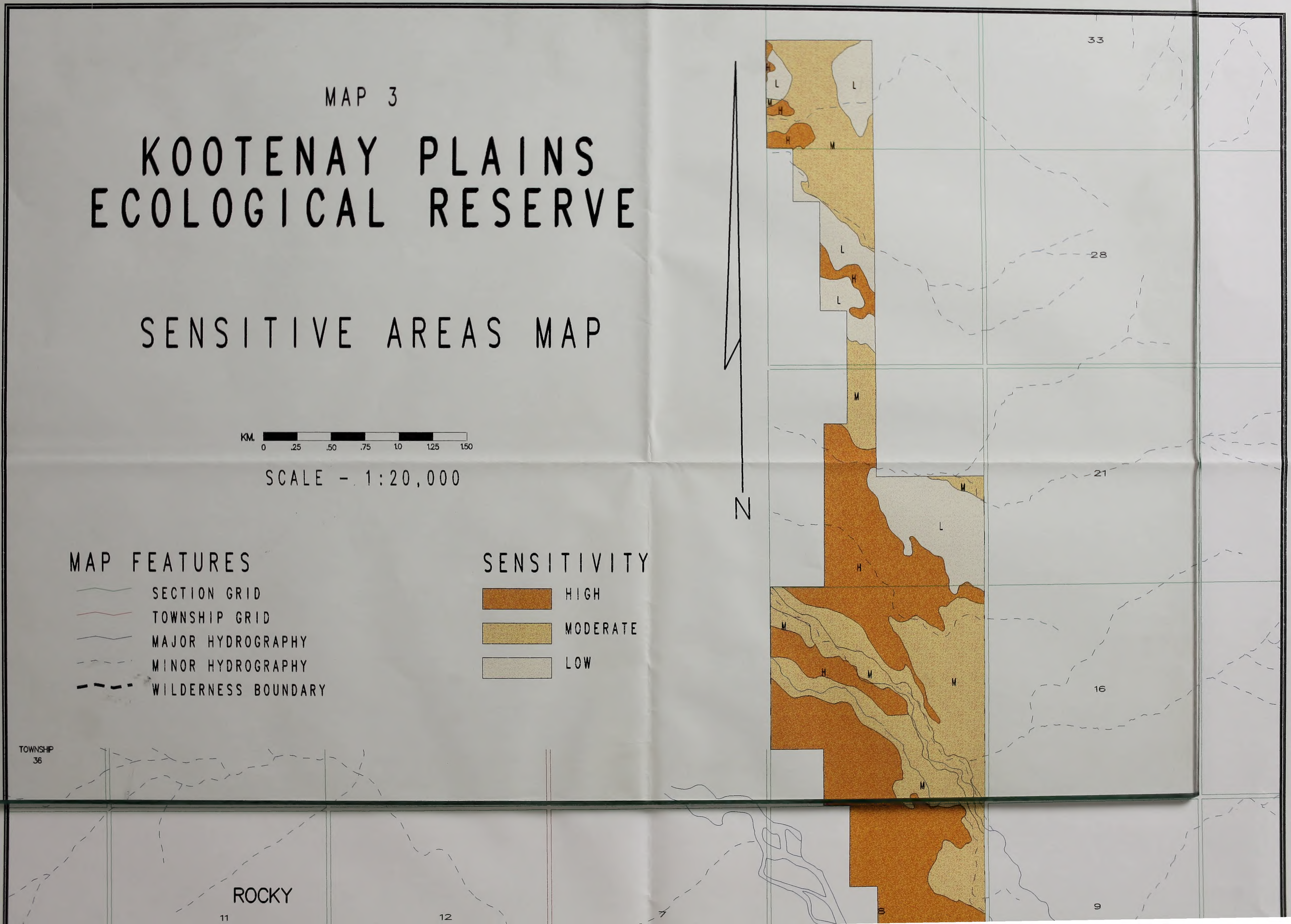


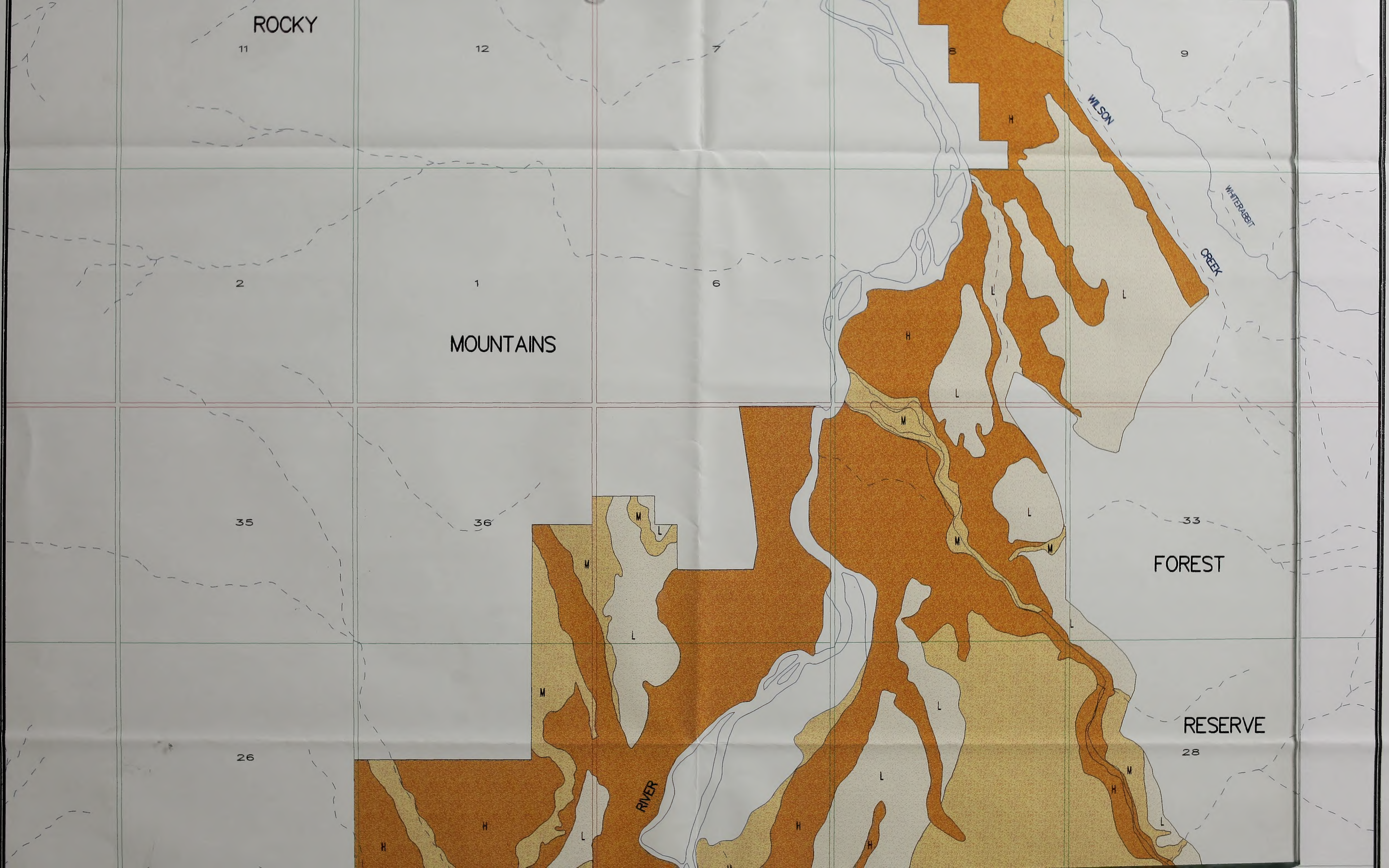
Interpretation and Mapping by:
GEOWEST Environmental Consultants Ltd.
Edmonton, Alberta
February, 1996

MAP 3

KOOTENAY PLAINS ECOLOGICAL RESERVE

SENSITIVE AREAS MAP




ROCKY
MOUNTAINS
FOREST
RESERVE
WILSON CREEK
WHITERABBIT
RIVER
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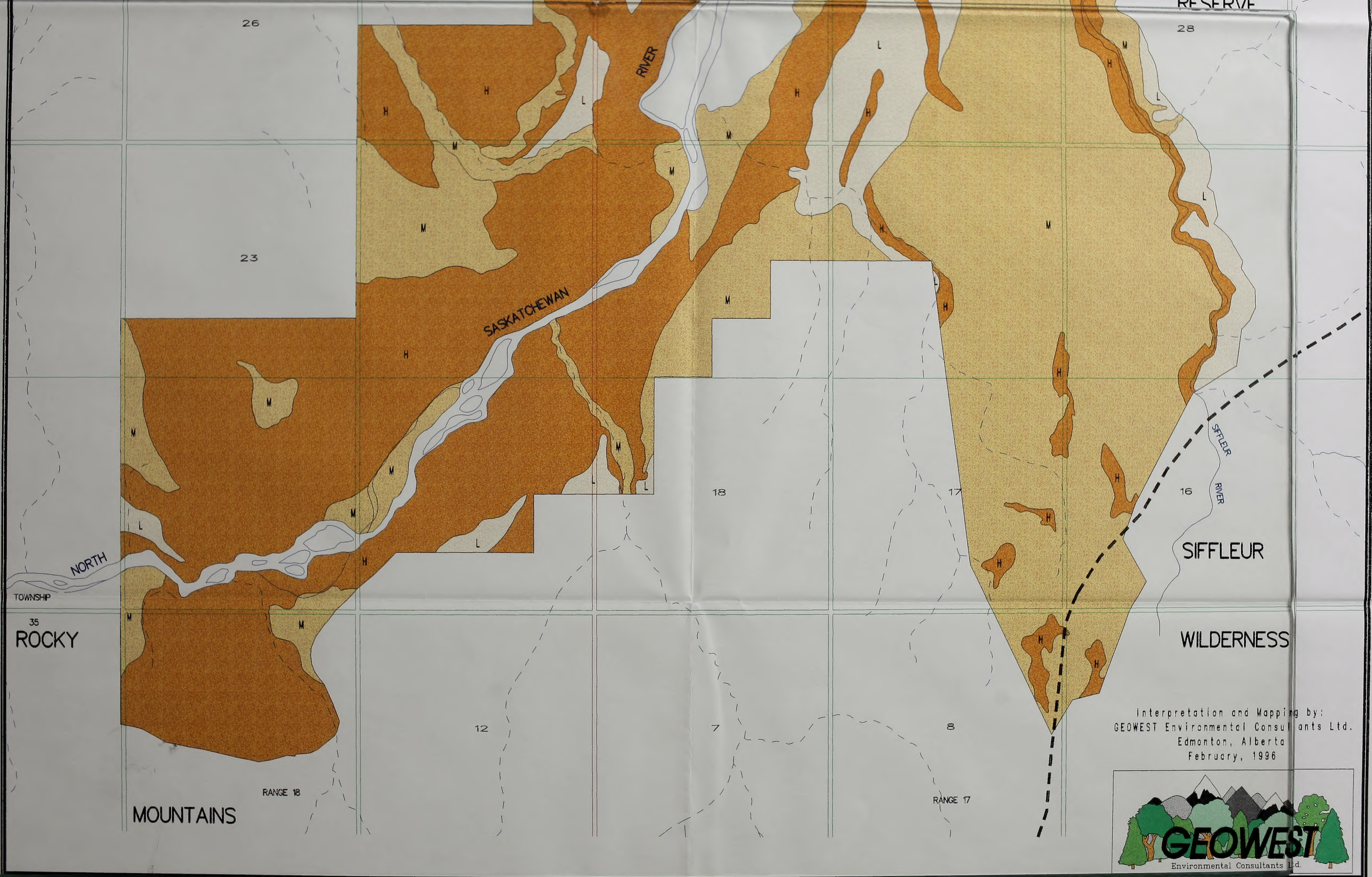

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